THE APPLICATION OF
PUSH-PULL TESTING TO
DEFINE BIOGEOCHEMICAL
CONTROLS ON SELENIUM AND
NITRATE ATTENUATION IN
SATURATED COAL WASTE ROCK

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Abstract

Surface mining of steelmaking coal in the Elk Valley, British Columbia, Canada, has resulted in the release of constituents of interest, such as selenium (Se) and nitrate (NO_3^-). Oxidation of sulfide minerals in the unsaturated coal waste rock generates water-soluble forms of Se (selenite (Se^{4+}) and selenate (Se^{6+})). Nitrate, introduced to waste rock through the blasting process, is also water soluble and mobile in the aqueous phase. Limited data suggest attenuation of Se and NO_3^- via reduction can occur in saturated waste rock, and therefore the placement of waste rock in topographic low areas, such as backfilled pits, could create conditions in which Se and NO_3^- attenuation would be enhanced. Key factors in the attenuation of these species are the reduction reaction rates and residence time of water in the saturated zone.

Water level measurements, slug testing, and groundwater age dating were conducted at the Henretta saturated backfill study area at the Fording River Operation to develop an understanding of the hydraulics of the saturated backfill. Geochemical data collected over approximately 2.5 years were used to examine changes in porewater chemistry over time with respect to individual species, and compare the relationship between species over time (i.e., Se/SO_4^{2-} and SO_4^{2-}/NO_3^-). A method to examine *in situ* reaction rates (push-pull testing) was developed and tested. Tests were able to identify the consumption of dissolved oxygen (DO) and interpret DO consumption using a first-order reaction equation. Push-pull tests were then conducted at two wells in the study area to determine if Se^{6+} and/or NO_3^- can be attenuated over a 3-day test period. Additional information on the reduction potential of the study area was gathered from Se speciation analysis, NO_3^- isotopes, and dissolved organic carbon concentrations.

Slug testing demonstrated that the waste rock is highly permeable (hydraulic conductivity on the order of 10^{-4} m/s), and tritium-helium age dating showed that water flow within the saturated fill is rapid. Although changes occurred in porewater geochemistry over time, the relative concentrations of SO_4^{2-} and NO_3^- remained stable. On the other hand, the relationship between Se and SO_4^{2-} varied over time, suggesting differences in the availability or attenuation of Se relative to SO_4^{2-}. Results of push-pull testing, Se speciation, and NO_3^- isotope analyses indicate no observable Se or NO_3^- reduction occurred at the site over the period of testing (i.e., 3 d).

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AEL	Aqueous and Environmental Geochemistry Laboratory
asl	Above sea level
B.C.	British Columbia
BGS	Below ground surface
CI	Constituent of interest
DNRA	Dissimilatory nitrate reduction to ammonium
DO	Dissolved oxygen
DOC	Dissolved Organic Carbon
FRO	Fording River Operation
HDPE	High-density polyethylene
HPLC-ICP-MS	High performance liquid chromatography inductively-coupled plasma mass spectrometry
IC	Ion chromatography
ICP-MS	Inductively-coupled plasma mass spectrometry
ICP-OES	Inductively-coupled plasma optical emission spectrometry
k	First-order reaction coefficient
K	Hydraulic conductivity
LDO	Luminescent dissolved oxygen
LDPE	Low-density polyethylene
n	Porosity
ORP	Oxidation-reduction potential
SpCond	Specific conductivity
TDS	Total dissolved solids
Temp	Temperature
v	Groundwater velocity
VSMOW	Vienna standard mean ocean water

1.0 INTRODUCTION

1.1 Overview

Coal has been mined in the Elk Valley, British Columbia (B.C.) since 1898. Large-scale surface mining has been ongoing since the late 1960s and today there are five open pit coal mines in the valley. A 2003 study by Lussier *et al.*, states that this large-scale mining produces 23.9×10^6 tonnes of coal and 140×10^6 tonnes of waste rock annually. Increases in both selenium (Se) and nitrate (NO_3^-) concentrations have been observed in surface and groundwater adjacent to these mines (Dessouki and Ryan, 2010; McDonald and Strosher, 1998). Nitrate is introduced to the system through blasting and Se is released as a result of oxidation of the waste rock (Dockrey *et al.*, 2015).

Selenium and NO_3^- are both redox sensitive species that can be harmful to the environment at elevated concentrations (Basu *et al*., 2007; Trudell *et al*., 1986). While the oxidized species of Se and nitrogen (N) are mobile in the aqueous phase, the reduced species can be attenuated. The attenuation of Se and NO_3^- through reduction in anoxic environments, such as those found in saturated waste rock (also called saturated backfills), could serve as an important mechanism to improve water quality. If NO_3^- and/or Se reduction is occurring in saturated backfills, knowledge of the rate at which these reactions are occurring, along with the residence time of water in the saturated backfill, will be crucial in evaluating the potential of saturated backfills as a form of treatment. Potential problems associated with scale dependency in reaction rates and the heterogeneity of waste rock piles makes *in situ* methods of measuring geochemical and hydraulic properties of the waste rock preferable to laboratory testing.

Teck Resources Limited (Teck), through their Applied Research and Development Program, is developing strategies to mitigate the release of aqueous concentrations of Se and NO_3^-, including the development of treatment methods and improved methods of placing waste rock (Teck, 2014). This research presents a method to determine *in situ* reaction rates in saturated backfills.

1.2 Research Objectives

For saturated backfills to be a viable water treatment option, reducing conditions as well as seasonal trends in flow and geochemistry must be understood. If sufficient reducing conditions are present in a saturated backfill for the reduction of NO_3^- and/or Se, these conditions must be maintained or there is a risk of remobilizing the reduced species. Large influxes of fresh water, such as the spring freshet, have the potential to flush the saturated backfill with oxidized water and change the reducing conditions (Kumar and Riyazuddin, 2011). Other physiochemical processes, such as sorption and chemical precipitation, must also be considered to understand processes controlling the movement of constituents of interest (CIs). Four objectives were identified to assess the potential of a saturated backfill to work as a mitigative measure for water quality and are as follows:

1. Characterize the geochemical and hydraulic conditions within a saturated backfill;
2. Develop and test a field protocol to quantify *in situ* geochemical reactions in saturated backfill environments;
3. Characterize the biogeochemical controls on Se and NO_3^- in a saturated backfill;
4. Evaluate the potential for the geochemical regime to enhance Se and NO_3^- attenuation in a saturated backfill.

The geochemical conditions encountered spatially and seasonally throughout a saturated backfill were investigated using historical water chemistry data collected by mine staff, as well as water chemistry data collected in the summer and fall of 2013 and 2014 from six groundwater wells and two stream monitoring locations. Groundwater samples were collected for analyses of NO_3^- isotopes, Se speciation, and dissolved organic carbon (DOC) to provide insight into the chemical processes acting on Se and NO_3^-, and possible controls on redox reactions and/or microbial activity. Additionally, water level data, stream flow monitoring, slug testing, and collection of groundwater samples for groundwater age analyses were used to define the rate of water movement through the saturated backfill. These data were used to provide a conceptual model of groundwater flow through the saturated backfill.

A method to conduct push-pull tests on saturated waste rock was developed and tested, and then used to accomplish objectives three and four. Push-pull tests are an *in situ* method in which water that contains both a reactive and conservative chemical species are injected and then withdrawn from an aquifer. The rate of loss associated with geochemical reactions is assessed by comparing the concentrations of the reactive species to that of a conservative species for which only dilution is causing a decrease in concentration. These tests were conducted at two different locations in the saturated backfill to assess spatial differences (different positions and depths).

2.0 BACKGROUND & LITERATURE REVIEW

Nitrate and Se are redox sensitive species and an understanding of their geochemical characteristics is necessary to understand their mobility in a saturated backfill. Knowledge of groundwater flow, as well as sources and interactions of Se and NO_3^- in the saturated backfill, are important to understand the transport of Se and NO_3^-. These topics will be discussed below, along with a review of literature related to push-pull testing.

2.1 Sources of Selenium and Nitrate from Coal Mining Activities in the Elk Valley

Coal mining in the Elk Valley occurs in the Mist Mountain Formation, which is of Jurassic-Cretaceous age and is part of the Kootenay Group (Ryan and Dittrick, 2001). Coal mining in the valley began in 1898, and since 1970, when surface mining began, 2.5 billion cubic meters of rock have been removed (as of 1999), with approximately 140 million tonnes of waste rock produced each year (Lussier *et al*., 2003; Ryan and Dittrick, 2001). Waste rock in the Elk Valley is mainly mudstone, sandstone, and siltstone, but also contains poor quality coal or coal from seams too thin to be economical to mine (Lussier *et al.*, 2003).

Surface mining involves blasting and removing huge quantities of rock, exposing the rock to new environmental conditions. Previously saturated material can become unsaturated and exposed to oxidizing and leaching conditions; and previously unsaturated material can become exposed to saturated conditions and undergo mineral dissolution (Dreher and Finkelman, 1992; Fala *et al*., 2005). These changes in redox conditions can influence the chemistry of water moving through waste rock piles. Infiltration of snowmelt and rainwater through waste rock piles can transport CIs such as Se and NO_3^- from the unsaturated zone to the saturated zone.

Selenium levels in the Elk River exceed the BC aquatic life guidelines (Dessouki and Ryan, 2010). The increasing concentrations of Se appear to be correlated to increasing cumulative waste rock produced by surface mining (Swanson, 2010). A study by McDonald and Strosher (1998) found that Se concentrations upstream of coal mines in the Elk Valley were consistently below 1 µg/L, while downstream of mines Se concentrations ranged between 2 and 20 µg/L (McDonald and Strosher, 2000). A study by Wellen *et al.* (2015) found that the most important source of Se was waste rock, accounting for approximately 80% of Se loading in the Elk Valley.

The average Se concentration in coal of the Mist Mountain formation is 1.6 ppm, which is elevated compared to the global crustal average of 0.05 to 0.1 ppm, but lower than the world average concentration for coals of 2.15 ppm (Ryan and Dittrick, 2001). Selenium in Elk Valley waste rock is associated with pyrite and sphalerite as well as barite, chalcopyrite, and secondary iron oxyhydroxides (Hendry *et al*., 2015). Selenium is easily incorporated into the crystal lattice structure of many sulphides (S^{2-}) and sulphates (SO_4^{2-}) (Kennedy *et al*., 2012).

Selenium in mine environments becomes mobile after atmospheric exposure and oxidation of Se to soluble species (Se^{6+} and Se^{4+}) (Hendry *et al*., 2015; Sharmasarkar, 1998). Oxidation occurs due to excavation, mixing, and dumping (Gerke *et al*., 1998). The most important pathway for the release of Se is the oxidation of pyrite and other S^{2-} minerals in waste rock (Kennedy *et al*., 2012). The oxidation of pyrite can be described by (Day *et al.*, 2012):

$$FeS_2 + {}^{15}\!/_{4}O_2 + {}^{7}\!/_{2}H_2O \rightarrow Fe(OH)_3 + 2SO_4^{2-} + 4H^+. \tag{2.3}$$

After dumping, oxidation will continue as long as oxygen, water, and pyrite are present. If oxygen is limited, such as in saturated backfills, the oxidation of pyrite is limited and the mobilization of Se is inhibited (Bianchin *et al*., 2013; Kennedy *et al.*, 2012). Hendry *et al.* (2015) found Se in secondary Fe oxyhydroxides, likely due to adsorption. They found that an average of 37% of Se released due to the oxidation of pyrite was sequestered on Fe oxyhydroxides. In this way, Fe oxyhydroxides act as a sink for Se in the unsaturated zone (Hendry *et al*., 2015).

As would be expected due to their common sources and release mechanism, leaching of Se and SO_4^{2-} is correlated at both laboratory and field scales (Kennedy *et al*., 2012). The ratio of Se/SO_4^{2-} in surface waters at Elk Valley mines is on the order of 10^{-4} (Day *et al.*, 2012). Sulfate and Se concentrations in surface waters draining mined areas in the Elk Valley tend to be lowest during the spring freshet, and increase as flow rates decrease through the summer and into the winter (Day *et al*., 2012). Selenium is transported as a conservative species under alkaline conditions unless reducing conditions develop. This indicates that it is present as SeO_4^{2-}, as lower oxidation states of Se are attenuated by adsorption and/or precipitation processes (Day *et al*., 2012).

Nitrogen (as NO_3^- and nitrite (NO_2^-)) concentrations are also increasing in the Elk Valley (Dessouki and Ryan, 2010). The soluble N in coal mining environments is the result of blasting activities associated with open pit mining (Dockrey *et al*., 2015). Ammonium nitrate/fuel oil (ANFO), is used as a blasting agent, and therefore NO_3^-, which is mobile in the aqueous phase, is introduced to the environment through transport with infiltrating water to groundwater and adjacent surface water receptors. This primarily occurs as leaching of residual ANFO from waste rock, but water can also accumulate NO_3^- from spillage of ANFO, incomplete detonation, or misfires (Dockrey *et al*., 2015; SRK, 2013). In the case of misfires, the blasting agent must either be re-fired or washed out. The NH_4^+ in ANFO will oxidize to NO_3^- if exposed to high potential redox conditions, such as those at blasting sites and unsaturated waste rock piles (Dockrey *et al*., 2015).

Nitrate is expected to behave conservatively in oxic water, but can be potentially attenuated under reducing conditions. In a study by Bianchin *et al.* (2013) of a backfilled pit of a coal mine in northern BC, both Se and NO_3^- concentrations were lower in the saturated zone of a backfilled pit as compared to up-gradient positions, whereas SO_4^{2-} concentrations remained elevated in the saturated zone of the backfilled pit. This suggested that the decrease in Se and NO_3^- concentrations was not due to dilution, but rather attenuation through reductive processes (Se reduction and denitrification). In this situation, the backfilled pit was acting as a passive bioreactor to improve water quality through the immobilization of Se and NO_3^- (Bianchin *et al.*, 2013).

2.2 Nitrate Geochemistry

Nitrogen can be present in the environment in a number of forms including NO_3^-, NO_2^-, nitric oxide (NO), nitrous oxide (N_2O), nitrogen gas (N_2), ammonia (NH_3), and ammonium (NH_4^+) (Figure 2.1). Nitrate present in groundwater at elevated concentrations can be attributed to anthropogenic activities such as agriculture, sewage disposal, and mining. Mining practices often use ANFO, which is highly soluble and rapidly dissociates into NO_3^- and NH_4^+ in water, as a blasting agent. Ammonium is oxidized to NO_2^- under aerobic conditions, and NO_2^- can be further oxidized to NO_3^- by nitrifying bacteria (Bailey *et al*., 2013).

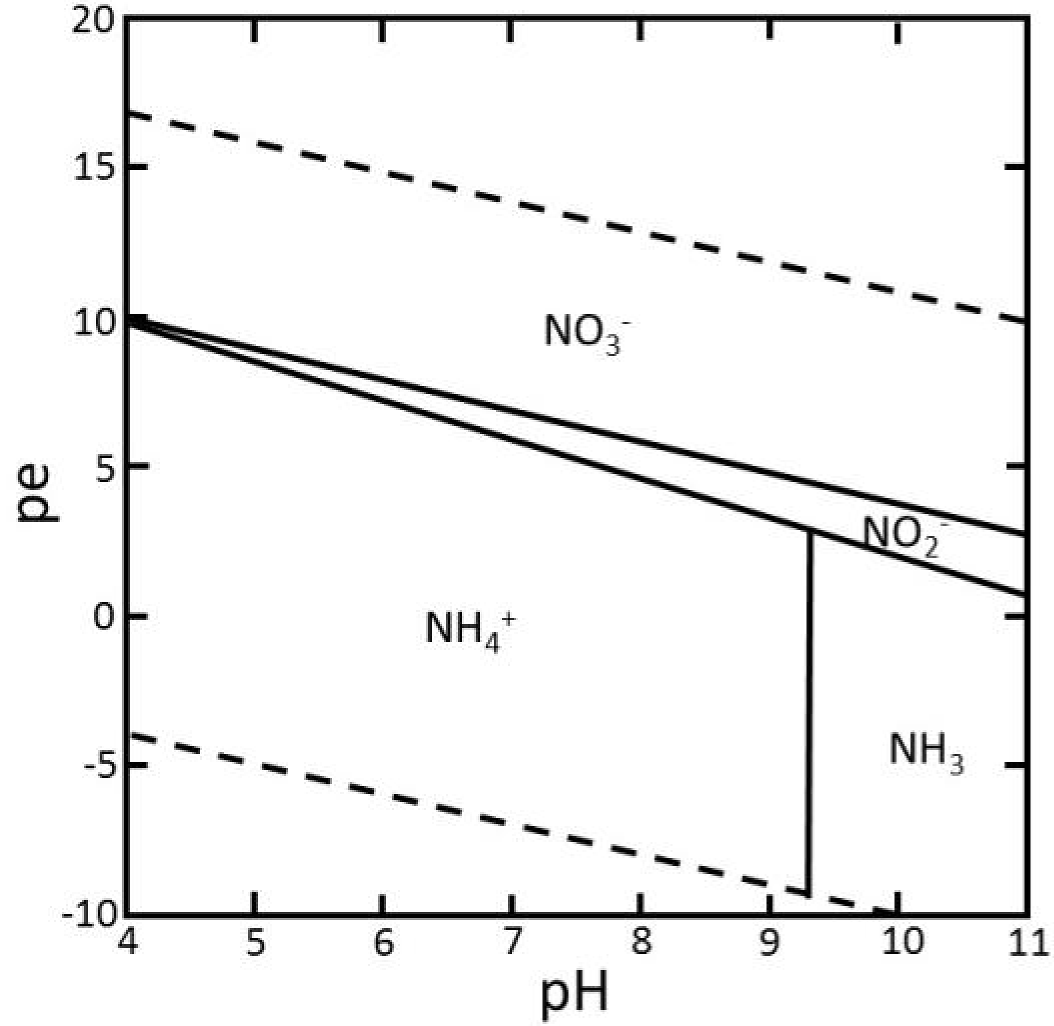

Figure 2.1. A Pourbaix diagram for nitrogen in a Fe-S environment at 25 °C and activities of 10^{-3}, 10^{-5}, and 10^{-2} for N, Fe, and S, respectively (after Dockrey *et al.*, 2015).

Denitrification is an important mechanism for the removal of NO_3^- from water. It is a microbially mediated process whereby NO_3^- is converted to N_2 (Korom, 1992; Trudell *et al.*, 1986). Other possible pathways for the conversion of NO_3^- to other N species include: (1) assimilatory NO_3^- reduction (N incorporated into the biomass of microbes), (2) dissimilatory NO_3^- reduction to NH_4^+, and (3) abiotic reduction of NO_3^- to N_2 (Schürmann *et al.*, 2003). Of these processes, only denitrification and abiotic reduction of NO_3^- are mechanisms of long-term N removal from the aqueous phase; the other processes only provide temporary removal of N (Korom, 1992; Starr and Gillham, 1993). Although both abiotic reduction and denitrification provide long-term controls on NO_3^- concentrations in water, abiotic reactions in the subsurface are considered minor compared to denitrification (Rivett *et al*., 2008).

According to Korom (1992), four general requirements for the occurrence of denitrification are: (1) the presence of NO_3^-, (2) the presence of bacteria capable of mediating the reduction of N species, (3) suitable electron donors (organic or inorganic), and (4) restricted oxygen (O_2) availability. The first requirement is readily met in most settings as NO_3^- is a common groundwater contaminant (Starr and Gillham, 1993). The remaining three requirements are discussed below.

In subsurface environments, bacteria obtain energy through the mediation of electron transfer reactions (Korom, 1992; Rivett *et al*., 2008). Common denitrifiers identified at coal mining sites in the Elk Valley include *Thiobacillus*, *Sphingobacteria*, *Nitratisoma*, and *Flavobacterium* (Environmin, Inc., 2013). Both facultative and obligate anaerobes use NO_3^- as an electron acceptor after O_2 is consumed. Thermodynamically, the reduction of O_2 yields more free energy than the reduction of NO_3^-, and so is favourable for microbes. Denitrification may not require the complete absence of O_2; it may occur if dissolved O_2 levels are below 1-2 mg/L (Rivett *et al*., 2008). There are also reports of simultaneous O_2 and NO_3^- reduction by specialized species of bacteria, but these are limited (Rivett *et al*., 2008). Due to the high degree of heterogeneity in subsurface environments, microenvironments can develop, and may have different reducing conditions than the bulk system (Chapelle, 1993; Rivett *et al*., 2008). In these microenvironments, local zones lacking oxygen may exist, allowing denitrification to occur.

Electron donors for denitrification can be either organic (organic carbon) or inorganic (reduced iron, Fe; manganese, Mn; or sulphur, S). When inorganic sources are utilized as electron donors in denitrification, the process is called autotrophic denitrification. This process can occur if NO_3^- is introduced into an environment with reduced Fe, Mn, or S and where appropriate bacteria are present (Korom, 1992; Rivett *et al.*, 2008). In such a setting, NO_3^- is thermodynamically unstable and can be reduced. Pyrite (FeS_2) is believed to be an important electron donor in anoxic environments, and NO_3^- has been shown to be capable of being the electron acceptor for microbial iron oxidation (Jørgensen *et al.,* 2009; Schwientek *et al.,* 2008). Pyrite oxidation coupled with denitrification proceeds very slowly and requires microbial catalysts (Jørgensen *et al.,* 2009; Schwientek *et al.,* 2008).

Heterotrophic denitrification occurs when organic carbon is used as an electron donor. Both the quantity and bioavailability of DOC is crucial for heterotrophic denitrification to occur. Trudell *et al.* (1986) report DOC values between 1.0 and 3.0 mg/L for samples from a site in an agricultural area with sandy surficial material and a shallow water table (depth < 4 m). Rivett *et al.* (2007) stated that DOC rarely exceeds 5 mg/L for aquifers in England and Wales, with mean values between 0.7 to 1.8 mg/L. Groundwater associated with coal may have higher concentrations (5-10 mg/L) of DOC, which may contain humic acid (Thurman, 1985).

Carbon material that is mature is assumed to be less bioavailable (labile) than immature material; furthermore, denitrification has been found to be minimal when organic carbon is present as lignite or coal fragments (Postma and Boesen, 1991; Rivett *et al*., 2008). Postma and Boesen (1991) examined denitrification where both pyrite and lignite were present and found pyrite to be much more reactive.

The end product of denitrification, N_2, has triple bonds between the N atoms and is stable and resistant to further chemical change (Korom, 1992). The half-equation for denitrification is (Tesoriero *et al*., 2000):

$$2NO_3^- + 12H^+ + 10e^- \rightarrow N_2 + 6H_2O. \tag{2.1}$$

The process of denitrification transforms NO_3^- to N_2 with intermediate steps leading to the temporary formation of NO_2^-, NO, and N_2O, and is (Korom, 1992; Wilson *at al.*, 1990):

$$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2. \tag{2.2}$$

This process may be stopped at any of the intermediate steps. Although NO_2^- is only stable in a small range of geochemical conditions, it can accumulate if there is a delay between the start of NO_3^- reduction and the start of NO_2^- reduction (Rivett *et al*., 2008). The accumulation of either NO or N_2O is unlikely, as they transform quickly into N_2 (Bailey *et al.*, 2013). It is possible that excess NO_3^- may cause the denitrification process to terminate at N_2O formation by inhibiting the formation of N_2 (Rivett *et al*., 2008).

In addition to inhibition due to excess NO_3^-, denitrification can be affected by a number of factors including: (1) limited nutrient availability (e.g., phosphorus) for bacteria, (2) strongly acidic environments, (3) temperatures outside the range of 2 to 50 °C, (4) high salinity, (5) the presence of metals, pesticides, or other compounds toxic to denitrifying bacteria, (6) small pore sizes that inhibit microbe growth, and (7) any environmental change that disrupts the microbial community (Rivett *et al*., 2008). The optimal temperature range for denitrification is 25 to 35 °C, with rates decreasing outside this range (Rivett *et al.*, 2008).

Dissimilatory NO_3^- reduction to NH_4^+ (DNRA) occurs in similar conditions to denitrification, but is not as commonly observed and is rarely the dominant NO_3^- reduction process in groundwater (Rivett *et al*., 2008). It is thought that DNRA is favoured when NO_3^- is limited and denitrification is favored when carbon is limited (Korom, 1992). High levels of NO_2^- are common in systems dominated by DNRA, but not in those dominated by denitrification (Rivett *et al*., 2008). There is evidence that DNRA and denitrification can occur simultaneously in the same environment (Schürmann *et al*., 2003). Assimilatory NO_3^- reduction is only expected to be a significant NO_3^- reduction process where microbial biomass is being extensively developed, such as during bioremediation (Rivett *et al*., 2008).

Nitrogen isotopes can be used to characterize the source of NO_3^- in groundwater and to indicate if NO_3^- reduction is occurring. Isotopes of an element behave in nearly the same way, except they have different reaction rates. Of the two stable isotopes of N, ^{14}N and ^{15}N, ^{14}N is the most abundant, comprising 99.632% of atmospheric N_2 (Flipse and Bonner, 1985). This abundance varies as a result of isotope fractionation, whereby either the light (^{14}N) or heavy (^{15}N) isotope is favoured in different processes.

Chemical or physicochemical fractionation occurs under equilibrium conditions and is the result of varying strengths of bonds formed by light or heavy isotopes. This leads to differences in reactions rates, where heavy isotopes, which form stronger bonds, are less likely to break apart and react than light isotopes (Clark and Fritz, 1997). This results in the heavy isotope being concentrated in the reactant, while the light isotope is concentrated in the product.

Kinetic fractionation is isotope fractionation under non-equilibrium conditions. Depending on the rate of the reaction, kinetic fractionation can enhance the amount of fractionation occurring (Clark and Fritz, 1997). In terms of N, kinetic fractionation favours ^{14}N in reactions, leading to the enrichment of ^{15}N in the reactant (Flipse and Bonner, 1985).

As NO_3^- is composed of both N and oxygen (O) molecules, the isotopes of both molecules can be used to identify processes, such as denitrification, that cause fractionation. In denitrification, light isotopes of N (^{14}N) and O (^{16}O) are favoured reactions, leading to an accumulation of heavy isotopes (^{15}N and ^{18}O) along the groundwater flow path. Typically, the ratio of enrichment of ^{18}O to ^{15}N in groundwater is 1:2, yielding a linear trend when $\delta^{18}O$ is plotted against $\delta^{15}N$, with increasing delta values for both ^{18}O and ^{15}N as denitrification occurs (Schwientek *et al*., 2008).

2.3 Selenium Geochemistry

Selenium (Se) exists in one of four oxidation states: selenate (Se^{6+}, SeO_4^{2-}), selenite (Se^{4+}, SeO_3^{2-}), elemental selenium (Se^0), and selenide (Se^{2-}) (Figure 2.2) (Seby *et al.*, 2001). Selenium is present in crustal material in average concentrations of 0.05 to 0.1 ppm, and is concentrated in coal (Ryan and Dittrick, 2001). Anaerobic conditions in coal swamps lead to the reduction and removal of Se from solution. Marine shales, particularly those of Cretaceous age, have higher Se concentrations because SeO_3^{2-} sorbs to clay minerals under high pH and salinity conditions (Fernández-Martínez and Charlet, 2009; Ryan and Dittrick, 2001). The sorbed SeO_3^{2-} can then be reduced to Se^0 or Se^{2-} and incorporated into sulphides such as pyrite, or remain attached to the clay mineral as a trace element (Ryan and Dittrick, 2001).

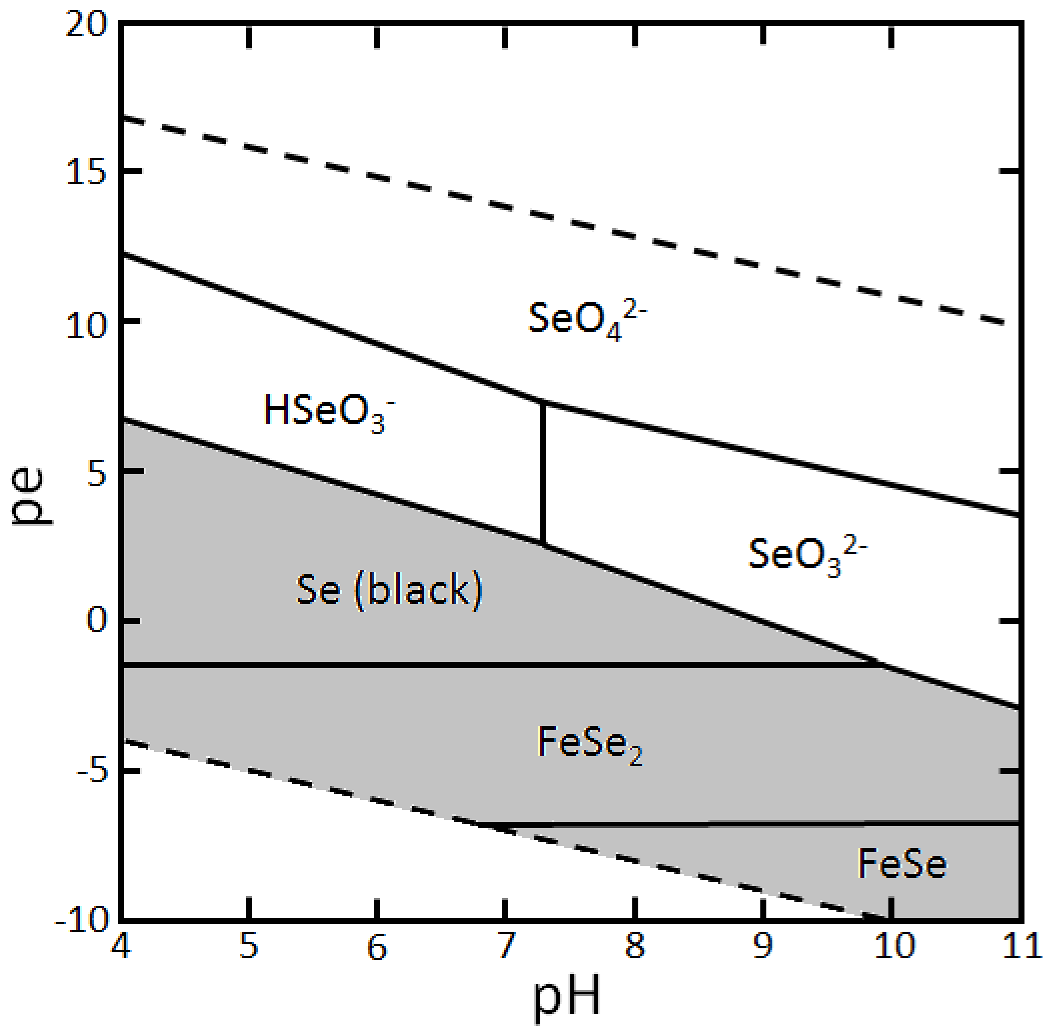

Figure 2.2. A Pourbaix diagram of selenium in a Fe-S environment at 25 °C and activities of 10^{-6}, 10^{-4}, and 10^{-2} for Se, Fe, and S, respectively (after Dockrey *et al.*, 2015).

Selenium geochemistry is similar to that of S due to their close proximity in Group 16 of the Periodic Table, and Se can substitute for S in organic compounds as well as minerals (Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010; Seby *et al*., 2001). Selenium can be either covalently bound within the molecular structure of organic material, or ionically bound to its surface (Lussier *et al*., 2003). Selenium is often present in soils, sediments, and ore deposits as iron selenide, where it is a substitute for sulphide and is stable over a range of geochemical conditions (Charlet *et al*., 2012; Scheinost and Charlet, 2008).

The form of Se is controlled by pH, chemical/mineralogical composition, sorbing surface, and redox state (Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010; Kumar and Riyazuddin, 2011). Selenate is limited to environments of high redox potential and moderate to alkaline pH, while Se^{4+} is expected to be the dominant species under intermediate redox conditions and pH; although the two species may coexist in many aquatic systems (Charlet *et al*., 2012; Kölbl, 1995). Selenium redox reactions proceed more favourably in the direction of reduction, and oxidation processes proceed very slowly, making it possible for Se^0 to be present in oxidizing conditions, although it normally exists in reducing environments over a wide pH range (Guo *et al*., 1999; Kumar and Riyazuddin, 2011; Seby *et al*., 2001). Selenide tends to persist in strongly reducing environments, and often forms insoluble metal selenides (Kumar and Riyazuddin, 2011; Seby *et al*., 2001). Selenium can also be present in organic compounds such as amino acids or methylated compounds (Seby *et al*., 2001). Thirty to 60% of total Se in fresh and marine waters may be present as organic Se, which can exist in complex compounds (Kölbl, 1995).

Both redox state and sorption surfaces are important when considering Se mobility. The oxidized species of Se, SeO_4^{2-} and SeO_3^{2-}, are mobile in aqueous solutions, whereas Se^0 and Se^{2-} have low solubility and thus low mobility (Fernández-Martínez and Charlet, 2009; Scheinost and Charlet, 2008). The mobility of SeO_3^{2-} is mainly controlled by sorption processes, as it has a high affinity for sorption sites and can form strong complexes (Fernández-Martínez and Charlet, 2009; Guo *et al*., 1999; Han *et al*., 2012). Selenate has a lower affinity for sorption than SeO_3^{2-} (Fernández-Martínez and Charlet, 2009; Guo *et al*., 1999; Han *et al*., 2012; Seby *et al*., 2001).

In batch experiments by Guo *et al.* (1999), SeO_4^{2-} was highly mobile, due to anion exclusion from the negatively charged mineral surfaces, while SeO_3^{2-} was adsorbed by soil. Han *et al.* (2012) show that SeO_3^{2-}, but not SeO_4^{2-}, is absorbed and reduced on the surface of pyrite. Zhang and Moore (1996) in their study of a wetland system, found that in surface sediment and core samples, organic Se and SeO_4^{2-} make up the majority of the adsorbed fraction, with very little Se present as SeO_3^{2-}, suggesting that SeO_4^{2-} may have a stronger affinity for sorption sites than SeO_3^{2-} in some environments. Both species have been shown to adsorb onto Fe oxides and hydroxides, particularly ferrihydrite (Das *et al*., 2013; Donovan and Ziemkiewicz, 2013; Yigit and Tozum, 2012). Se oxyanions can also be sorbed to organic matter, apatite, and aluminum and other metal oxides (Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010).

Sulphate (SO_4^{2-}), NO_3^-, and phosphate (PO_4^{3-}) are possible competitors for sorption sites with Se (Dhillon and Dhillon, 2000; Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010;

Han *et al*., 2012; Kumar and Riyazuddin, 2011). Phosphate has the greatest effect with respect to reducing Se adsorption, followed by NO_3^- and then SO_4^{2-} (Dhillon and Dhillon, 2000; Han *et al*., 2012). Se sorption onto Fe and Al oxides surfaces is highest at low pH because of the positive surface charge developed at low pH values (Fernández-Martínez and Charlet, 2009).

Selenium species can form either inner or outer sphere complexes. Outer sphere complexes are formed due to electrostatic attraction, and are strongly dependent on surface charge and the ionic strength of the solution. Inner sphere complexes form when bonds (covalent or ionic) are formed at a crystallographic site (Fernández-Martínez and Charlet, 2009). Of the two, inner sphere complexes are more stable. Selenite generally forms inner sphere complexes (Fernández-Martínez and Charlet, 2009). Das *et al.* (2013) found that SeO_4^{2-} formed inner sphere complexes on iron oxy-hydroxides at neutral pH.

Substitution of Se in the crystalline structure of minerals, particularly apatite and calcite, can also serve as a mechanism to immobilize Se (Fernandez-Martinez and Charlet, 2009). Due to the similarity between SeO_4^{2-} and PO_4^{3-} anions, apatites are a strong candidate to control SeO_4^{2-} mobility. In the same way, the similarity between SeO_3^{2-} and carbonate may allow for the incorporation of Se^{4+} into calcite (Fernández-Martínez and Charlet, 2009).

Reductive precipitation of the oxidized species of Se is thought to be the most effective immobilization process, and adsorptive removal (with subsequent reduction) has been adopted as the Best Demonstrated Available Technology by the US EPA (Charlet *et al*., 2012; Han *et al*., 2012). The reduction of Se^{6+} can be either mediated by microorganisms, where Se^{6+} acts as an electron acceptor during anaerobic microbe respiration, or can be an abiotic process at the surface of ferrous iron containing solids such as green rust or pyrite (Fernández-Martínez and Charlet, 2009; Scheinost and Charlet, 2008). Methods of bioremediation, which employ microbially mediated reduction to remove Se from the aqueous phase, are less favourable than abiotic reduction at the field scale due to the high cost of chemical nutrients (Han *et al*., 2012).

Batch experiments conducted by Guo *et al.* (1999) show that rates of SeO_3^{2-} reduction in soil decreased after sterilization of the substrate. This indicates that microbes play a significant role in the reduction of SeO_3^{2-} to Se^0. The reduction of SeO_4^{2-} is fast in soil columns, and increases with organic amendments and low levels of oxygen. The highest reduction rates in this study correspond to a half-life of 10 hours for SeO_4^{2-} (Guo *et al.*, 1999).

Selenium speciation and bioavailability are affected by the presence of microorganisms in the environment, which influence the oxidation state and thus the solubility of Se (Bao *et al.*, 2013; Fernández-Martínez and Charlet, 2009). Bacteria can use SeO_3^{2-} and SeO_4^{2-} as terminal electron acceptors in both dissimilatory reduction (energy metabolism) and assimilatory reduction (incorporation into the organic compounds of the bacteria) (Fernández-Martínez and Charlet, 2009; Scheinost and Charlet, 2008). Selenium reduction can be carried out by a range of microbes. *Pseudomonas*, *Cupriavidus*, *Anaeromyxobacter*, *Geobacter*, and *Senotrophomonas* have all been identified as Se reducing genera (Environmin, Inc., 2013). Selenate reduction to SeO_3^{2-} is energetically favourable, but yields less free energy than NO_3^- reduction to N_2. As denitrification offers microbes a slightly higher energy yield, there are concerns that NO_3^- is a competing electron acceptor and may inhibit Se reduction (Bao *et al.*, 2013; Enviromin Inc., 2013). This possibility will be examined further in Section 3.6.

Selenium isotopes can be used to determine the occurrence of redox reactions, which in turn influence Se solubility and bioavailability. Reduction of Se leads to isotopic fractionation, and therefore isotopic analysis may indicate the occurrence of reduction in the environment from which a sample is taken. Because isotopic fraction favours the lighter isotope, enrichment of the heavier isotope along a flow path would indicate the occurrence of reduction (Johnson, 2004).

In addition to indicating if reduction is occurring, Se isotopic fractionation may indicate if the reduction is abiotic or biotic. Johnson (2004) noted that, for the reduction of SeO_4^{2-}, microbial reductions have fractionations of less than 5‰; while abiotic reductions have fractionations of greater than 7.3‰. There is little to no isotopic fractionation of Se during sorption or precipitation reactions or uptake by plants, so these processes would not change the isotopic signature (Johnson, 2004).

2.4 Relationship between Selenium and Nitrate

As mentioned in the previous section, leaching of Se and SO_4^{2-} is correlated (Kennedy *et al.*, 2012). Locations with high Se/SO_4^{2-} ratios have strong correlations between Se and indicators of weathering (calcium (Ca), magnesium (Mg)); whereas there is a weaker correlation between Se and these cations at locations with lower Se/SO_4^{2-} ratios (Dockrey *et al.*, 2015). This indicates that there is a process affecting Se mobilization that is not influencing SO_4^{2-}, Ca, or Mg concentrations. Where Se concentrations decline while SO_4^{2-} concentrations remain elevated (low Se/SO_4^{2-} ratio), Se maintains its correlation with NO_3^-. This indicates that the process attenuating Se is also attenuating NO_3^-. Only anaerobic reduction has the potential to attenuate both Se and NO_3^- (Dockrey *et al*., 2015).

The presence of NO_3^- complicates Se geochemistry as it can inhibit Se reduction (Bailey *et al*., 2012). Thermodynamically, NO_3^- reduction yields (slightly) more free energy than Se^{6+}, and is expected to occur at higher redox potentials (Bao *et al*., 2013; Dockrey *et al.*, 2015; Enviromin Inc., 2013). The influence of NO_3^- on Se reduction is not well understood; it has been shown to inhibit Se reduction at concentrations as low as 1 mg/L NO_3^- as N (Bailey *et al*., 2012), whereas other studies have demonstrated simultaneous NO_3^- and Se reduction (Bianchin *et al*., 2013; Oremland *et al*., 1999). It is likely that there is a threshold concentration of NO_3^- below which both NO_3^- and Se reduction can occur simultaneously, and this concentration is likely low and dependent on environmental conditions (Dockrey *et al.*, 2015). There may be zones of Se reduction within areas of NO_3^- reduction due to the high degree of spatial heterogeneity of waste rock environments (Rivett *et al*., 2008).

Adding to the complexity of NO_3^- - Se interactions is the potential for NO_3^- to oxidize both Se-bearing pyrite and other reduced forms of Se in the absence of oxygen (Bailey *et al*., 2012; Schwientek *et al*., 2008). The rate of pyrite oxidation by NO_3^- has been found to increase with increasing NO_3^- concentrations and decreased pyrite grain size. The oxidation of Se-bearing pyrite can be shown as (from Dockrey *et al*., 2015):

$$5Fe(Se,S)_2 + 14NO_3^- + 4H^+ \rightarrow 5Fe^{2+} + 10(SeO_4^{2-}, SO_4^{2-}) + 7N_2 + 2H_2O. \qquad (2.4)$$

Experiments by Jørgensen *et al*. (2009) found no significant NO_3^- reduction in the presence of pyrite where microbes were inhibited, but significant NO_3^- reduction where microbes were not inhibited, indicating that this process requires a microbial catalyst to occur at significant rates.

2.5 Groundwater Flow in Saturated Waste Rock

In surface mining, explosives and machinery are used to fracture and remove overburden (Dickens *et al*., 1989; Hawkins, 2004; Wellen *et al*., 2015). The resulting waste rock consists of a range of particle sizes that can span six orders of magnitude (Fala *et al*., 2005). Waste rock piles at BC coal mines tend to have a wide range of particle sizes and a higher percentage of coarse material than other North American and European coal mines (Smith *et al*., 1995). This waste rock is deposited in piles or dumps, or can be used to backfill previously mined areas (backfilled pits). During the mining process, pre-existing aquifers are destroyed and new aquifer characteristics develop in the backfill (Hawkins, 2004). Waste rock piles can be hundreds of meters high and several kilometers in length, and can consist of both saturated and unsaturated zones (Corazao Gallegos, 2007; Day *et al*., 2012).

During the creation of waste rock piles, material is dumped from trucks and spills downslope. This process, called end dumping, results in a generally segregated pile, with coarse materials at the base and fine materials nearer to the surface (Corazao Gallegos, 2007; Fala *et al.*, 2005; Amos *et al.,* 2015). Depending on the construction of the pile, coarse material can be found throughout, and waste rock piles are often highly heterogeneous (Bay, 2009; Corazao Gallegos, 2007; Dickens *et al*., 1989; Donovan and Ziemkiewicz, 2013; Hawkins, 2004; Amos *et al.,* 2015).

The excavation and dumping of waste rock leads to an increase in void space, which, when combined with above ground waste rock placement, creates, on average, well drained, unsaturated waste rock. This well drained, unsaturated waste rock undergoes higher rates of recharge and water movement as well as increased accessibility to oxygen ingress through both diffusive and convective air flow (Barbour *et al.,* 2016; Dickens *et al*., 1989). The lack of forest cover reduces evapotranspiration, increasing the amount of water available to infiltrate the waste rock pile (Dickens *et al*., 1989). During winter, infiltration is low as precipitation accumulates on the ground surface as snow. During this time, the ingress of air continues and therefore oxidation within the unsaturated portions of the waste rock pile will continue. The reaction products formed during winter are then flushed in the spring with snowmelt and rainfall (Donovan and Ziemkiewicz, 2013). In cold climates, the accumulation and melting of snow significantly affects the hydrological cycle (Wellen *et al.*, 2015). Recharge of the waste rock pile through the infiltration of snow melt and rain results in periodic flushing of the waste rock, which may also change the position of the water table (Hawkins, 2004).

Groundwater flow in waste rock is thought to be similar to that in a porous media system such as unconsolidated alluvium (Hawkins, 1998). Waste rock may act as a porous media under steady-state conditions, but under transient conditions may exhibit dual porosity (Hawkins, 1998). Macropores, which exist within a matrix of finer material, can account for a substantial percentage of the volume in a backfill, and can store and transport large volumes of water (Hawkins, 2004).

In dual porosity, advective transport occurs in the macropores while diffusion transfers mass into the porous matrix. In a heterogeneous system, macropores may be discontinuous or absent where fine grained particles are more abundant (Smith *et al*., 1995). Where rock fragments are coarse, it is likely that flow is dominated by preferential flow in macropores (Hawkins, 1998).

Associated with the heterogeneity of waste rocks piles is spatial variability in hydraulic conductivity (K). Lower K areas may consist of finer textured zones or higher compacted zones such as haul roads (Bay, 2009; Smith *et al*., 1995; Amos *et al.*, 2015). These lower K areas would allow less groundwater flow through them and contribute little to flow (Fala *et al*., 2005; Hawkins, 1998). The low K areas may still be accessible to diffusion of mass into the pore space if a concentration gradient is present. In this way, the low K areas can store and release mass but not contribute to groundwater flow.

The K of waste rock is greater than for natural bedrock (Bianchin *et al*., 2013; Wunsch *et al*., 1999). Smith *et al.* (1995) states that K values for waste rock piles are generally between 10^{-6} and 10^{-4} m/s, and Neuner *et al.* (2013) found K values between 2×10^{-6} to 3×10^{-5} m/s for waste rock in a permafrost terrain. Hawkins (1998) studied coal waste rock in the Northern Appalachians, and found that mine waste rock was approximately 100 times more conductive than the adjacent (undisturbed) bedrock. As a result, water often infiltrates the waste rock piles until the underlying, lower K bedrock is encountered. At this depth, groundwater flow follows the topography of the underlying bedrock.

2.6 Push-Pull Tests

In push-pull testing, water spiked with tracers is injected into a formation through a well and, after some time, the water is extracted from that same well. Water samples collected throughout the process are used to characterize changes in concentration as a result of both mixing and geochemical processes. Push-pull tests have potential use in determining physical (e.g., effective porosity, longitudinal dispersivity), chemical (e.g., reaction processes and rates), and biological (e.g., microbial reduction processes and rates) characteristics of saturated geologic formations. An *in situ* method is considered to be more representative of actual formation characteristics than laboratory testing methods because it tests a larger and intact volume of the formation. Push-pull tests require the use of only one well. This can be a cost-saving factor if well installation is necessary to conduct tests, or can allow for multiple tests to be conducted at the same site if more than one well exists (Snodgrass and Kitanidis, 1998; Istok *et al.*, 1997).

A push-pull test has a series of basic test phases: (1) water is extracted from a monitoring well, (2) the water is spiked with one or more conservative tracers and one or more reactive solutes, (3) the spiked solution is injected into the well and adjacent saturated geologic media and allowed to react for a period of time, (4) after a reaction time, the water is extracted from the well, and (5) concentrations of the conservative tracers and reactive solutes are measured with time and volume extracted (Figure 2.3) (Haggerty *et al.*, 1998). During the reaction time, the concentration of reactive tracers may be altered through sorption, precipitation, redox reactions, or microbial consumption.

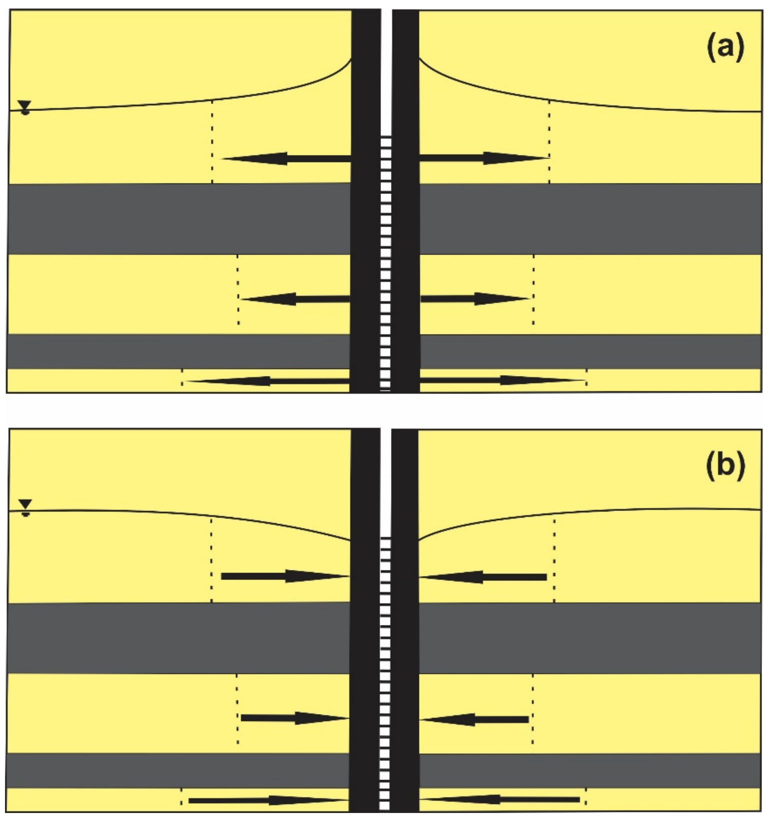

Figure 2.3. Illustration of the injection ('push') (a) and extraction ('pull') (b) phases of a push-pull test. The dark gray areas represent aquitards (after Haggerty *et al.*, 1998).

Dilution of the injected water by mixing with the formation water will occur during the injection, reaction time, and extraction phases of the test. This might occur as a result of diffusion/dispersion processes, mixing with formation water flowing past the well, or preferential injection and/or withdrawal pathways of the spiked water. As the water is extracted during the pull phase, dilution of the reactive solutes can be determined from the decline in the concentration of the conservative tracer(s); any further concentration loss in the reactive solute(s) can be attributed to physical-chemical reactions (Figure 2.4) (Haggerty *et al.*, 1998; Trudell *et al*., 1986). With this method, it is possible to determine if the reactive tracer is being attenuated and, if so, examine *in situ* reaction rates. Measurements can also be made for species and/or isotopes relevant to possible reactions involving reactive tracers. Information on relevant species/isotopes may also provide insight on the mechanism of attenuation of the reactive tracer.

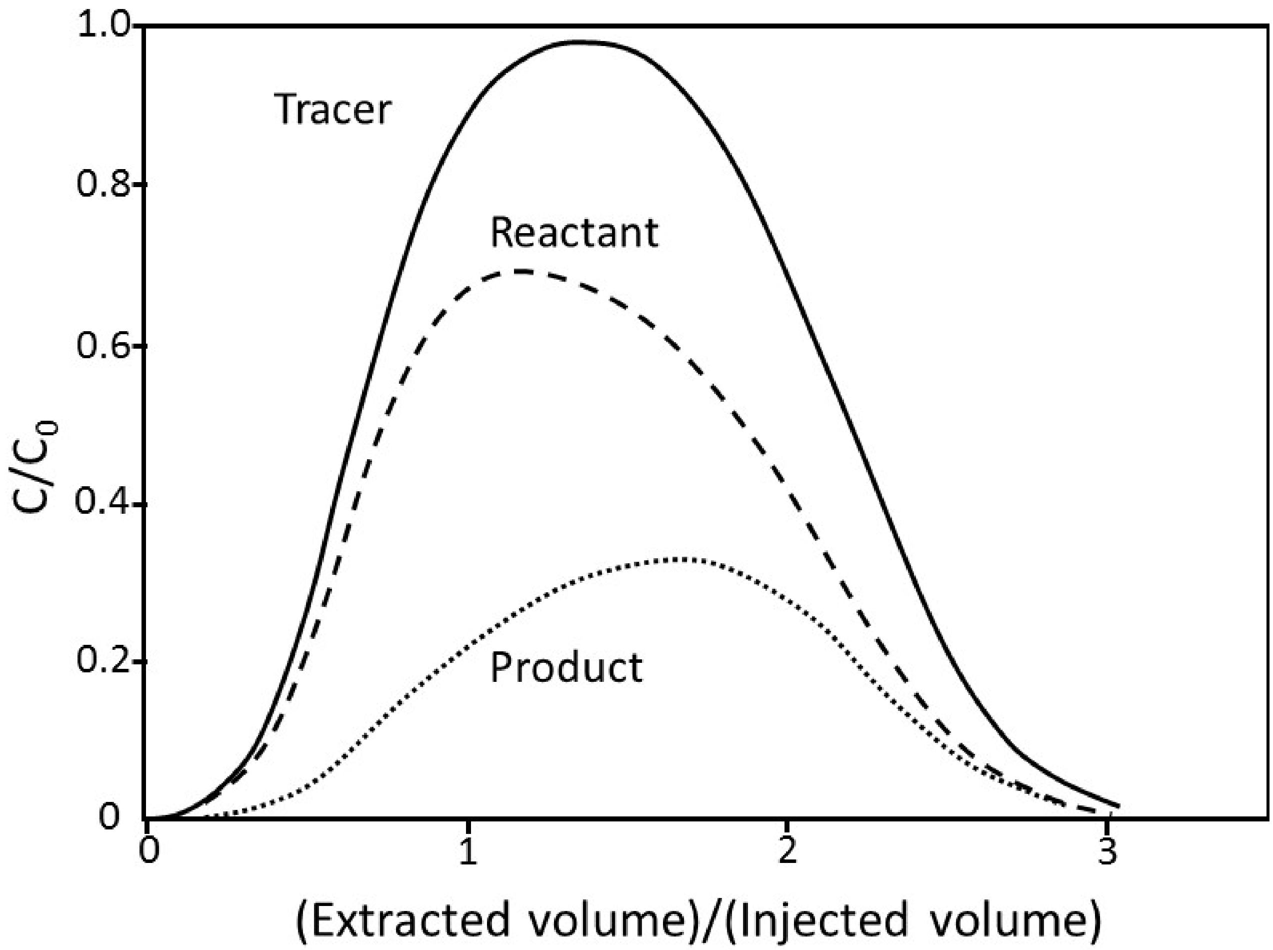

Figure 2.4. Plot of expected results from a push-pull test. The 'tracer' plot is the normalized concentration of the conservative tracer, the 'reactant' plot is the normalized concentration of the reactive tracer, and the 'product' plot is the normalized concentration of the product formed from the reactive tracer (after Istok *et al.*, 1997).

Many studies (Schroth and Istok, 2006; Schroth and Istok, 2005, Haggerty *et al.*, 1998; Snodgrass and Kitanidis, 1998) provide semi-analytical or approximate analytical methods to determine first-order reaction coefficients (k) from push-pull tests. These methods are desirable as they do not require details on aquifer properties (e.g., K, porosity (n)), but are of limited use for aquifers that are highly heterogeneous or anisotropic (Haggerty *et al.*, 1998). Haggerty's (1998) solution involves plotting the natural log of relative concentration of the reactive tracer, C_r, divided by the relative concentration of the conservative tracer, C_c, versus time elapsed since the end of injection, t [T]. The slope of this plot yields an estimate of the first-order reaction rate coefficient, k [T^{-1}] (from Haggerty *et al.*, 1998):

$$\ln\left(\frac{C_r(t)}{C_c(t)}\right) = \ln\left[\frac{(1-e^{-kt_{inj}})}{kt_{inj}}\right]-kt\ , \tag{2.5}$$

where relative concentrations are normalized to background conditions and t_{inj} [T] is the injection duration. This method assumes the injected solution quickly becomes well mixed and retardation of the tracer and reactant are the same (Haggerty *et al*., 1998a).

Schroth and Istok (2006) compare Haggerty's "well mixed" model to two different mixing scenarios: (1) "plug flow", which assumes that the first particle injected is the last extracted, and (2) "variably mixed", which assumes that particles injected early in the injection phase travel further than those injected later, and therefore have a larger spread (Schroth and Istok, 2006). The solution for the plug flow model involves calculating a residence time for each particle, while a weighted mean residence time is calculated for each particle for the variably mixed model. Estimates of k [T^{-1}] are then obtained using (from Schroth and Istok, 2006):

$$\ln\left(\frac{C_r(t)}{C_c(t)}\right) = -kt_r\ , \tag{2.6}$$

where t_r [T] is either the residence time for the particle (plug flow) or the weighted mean residence time (variably mixed model). The authors note that finding the weighted mean residence is difficult.

In addition to first-order reaction rates, Snodgrass and Kitanidis (1998) present a method for the estimation of zero-order reaction rate coefficients using:

$$C_r(t) = C_r^0\left(\frac{C_r^m(t)}{C_r^0} - \frac{C_c^m(t)}{C_c^0} + 1\right)\ , \tag{2.7}$$

where the subscripts r and c refer to the reactive and conservative species, respectively, and the superscripts 0 and m refer to initial concentration and the measured concentration at time t, respectively. The authors then used the calculated C_r to calculate a zero-order reaction rate.

Trudell (1986) conducted push-pull tests using bromide (Br^-) as a conservative tracer and NO_3^- as the reactive solute. His results show a decline in the dissolved oxygen (DO) concentrations initially following injection, followed by a decline in NO_3^-. The declines in both DO and NO_3^- were much greater than the decline in Br^- concentration. The authors assume that any loss of NO_3^- above the decrease in concentration seen in Br^- could be attributed to denitrification. Changes in the concentration of bicarbonate, a by-product of denitrification, were also monitored and increased as NO_3^- concentrations decreased (Trudell *et al.*, 1986).

A push-pull test conducted by Vandenbohede and Lebbe (2006) also used Br^- as a conservative tracer and both DO and NO_3^- as reactive solutes. In agreement with results of Trudell (1986), DO concentrations in the Vandenbohede and Lebbe study decreased sharply at the onset of extraction. The DO was consumed by reaction with the organic matter in the sediments. When most of the DO was consumed (reached very low concentrations), NO_3^- concentrations started to decrease. Nitrate was consumed by bacterially-catalyzed denitrification and had a first-order reaction rate coefficient (k) of 0.731 h^{-1}. As in the Trudell study, Vandenbohede and Lebbe noted that bicarbonate concentrations remained constant prior to denitrification, and began to increase after the onset of denitrification (Vandenbohede and Lebbe, 2006).

Schurmann *et al.* (2003) also studied denitrification in an aquifer using push-pull tests. In addition to using Br^- as a conservative tracer and NO_3^- as a reactive tracer, they used NO_3^- enriched with ^{15}N to isotopically track the N transformations in the aquifer. The authors were able to calculate a k for NO_3^- consumption from the change in concentration of NO_3^- during the push-pull test, and identify NO_3^--consuming processes by measuring the concentration and isotopic composition of other N species. The k value was determined to be between 0.39 and 0.43 day^{-1}. Denitrification did not account for all NO_3^- consumption in the aquifer, as DNRA, abiotic NO_3^- reduction, and assimilatory NO_3^- reduction also contributed (Schürmann *et al.*, 2003).

3.0 DESCRIPTION OF THE STUDY AREA

This research was conducted at the Fording River Operations (FRO) mine site in the Elk Valley of southeast B.C. (Figure 3.1). FRO is located 29 km northeast of the town of Elkford. Annual precipitation in Sparwood, B.C is about 600 mm/a (elevation: 1136.7 m asl) (Figure 3.1) (Wellen *et al.,* 2015). Using a precipitation lapse rate of +21 mm/ 100 m, annual precipitation in the Henretta area of FRO is projected to be about 726 mm/a, much of which accumulates as snow (Barbour *et al*., 2016; Wellen *et al.*, 2015). Coal mining in the Elk Valley occurs in the Mist Mountain Formation, which is of Jurassic-Cretaceous age (Ryan and Dittrick, 2001), and waste rock consists mainly of mudstone and siltstone (Lussier *et al*., 2003). Waste rock (including coal in seams too thin or poor quality to mine economically) is deposited in dumps or backfills that can be hundreds of meters high and kilometers long (Corazao Gallegos, 2007; Day *et al*., 2012; Lussier *et al*., 2003).

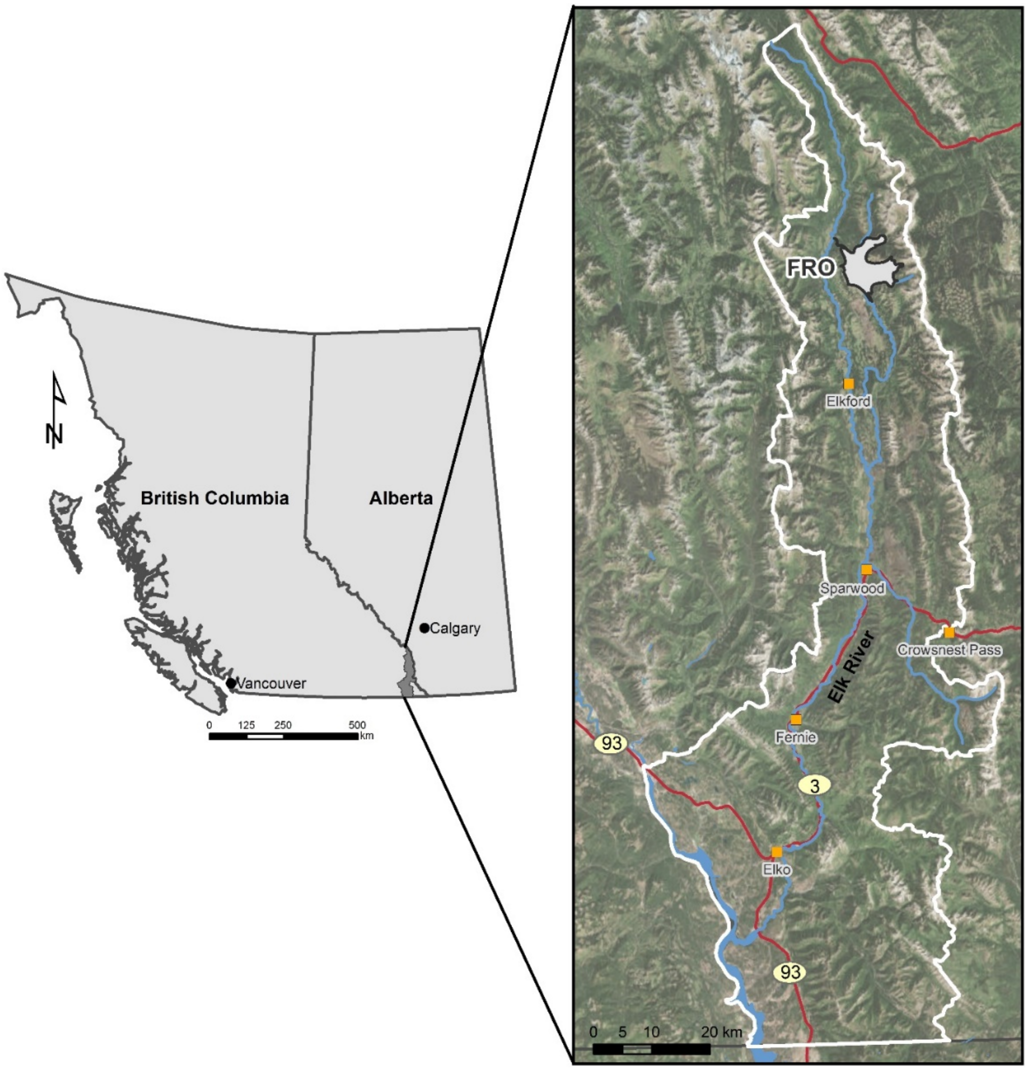

Figure 3.1. Map showing the Elk Valley, British Columbia, Canada. The Fording River Operations (grey), water bodies (light blue), and the boundaries of the watershed (white) are also shown (after Hendry *et al.*, 2015).

Testing was conducted at monitoring wells in the Henretta ridge area of FRO (Figure 3.2). The study area is a mountain valley, with Henretta Creek running through its base. The creek drains into Henretta Lake (Figure 3.2), which in turn is drained by the lower portion of Henretta Creek that eventually joins the Fording River. Both the creek and lake sit atop a previously mined area that has been backfilled with waste rock (saturated backfill) (Figures 3.3 and 3.4). Research was conducted on this saturated backfill.

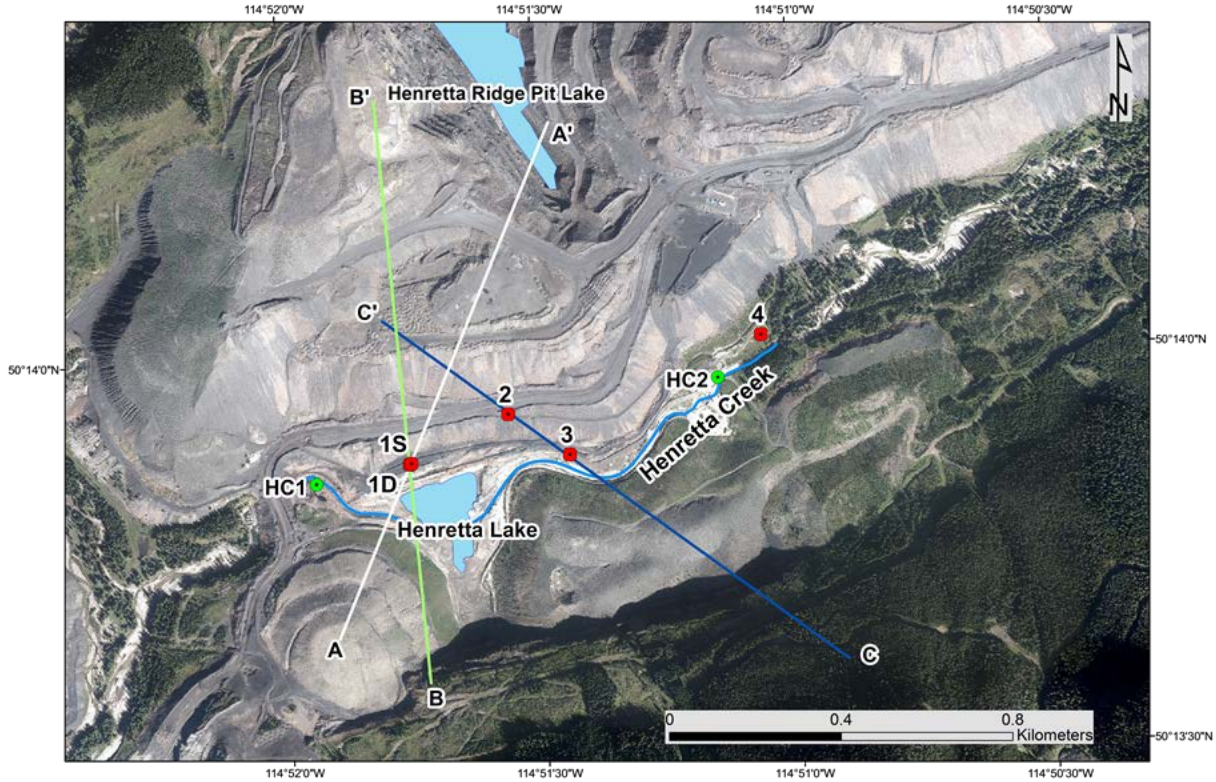

Figure 3.2. Map showing the Henretta study area, including groundwater monitoring wells (orange circles) (Symbols for Wells 1S and 1D overlap due to their close proximity) and stream monitoring locations (green circles). Monitoring Well 5 is not shown on this map, but is located along the undisturbed (past the extent of mining) creek bed approximately 2.3 km to the NE of Well 4. Also shown are traces of cross sections running from SW to NE (A-A'; white line, approximately 1.3 km in length), from SE to NW (B-B'; green line, approximately 1.4 km in length), and from SW to NE through Wells 2 and 3 (C-C'; navy blue line, approximately 1.3 km in length). The direction of stream flow from east to west (right to left).

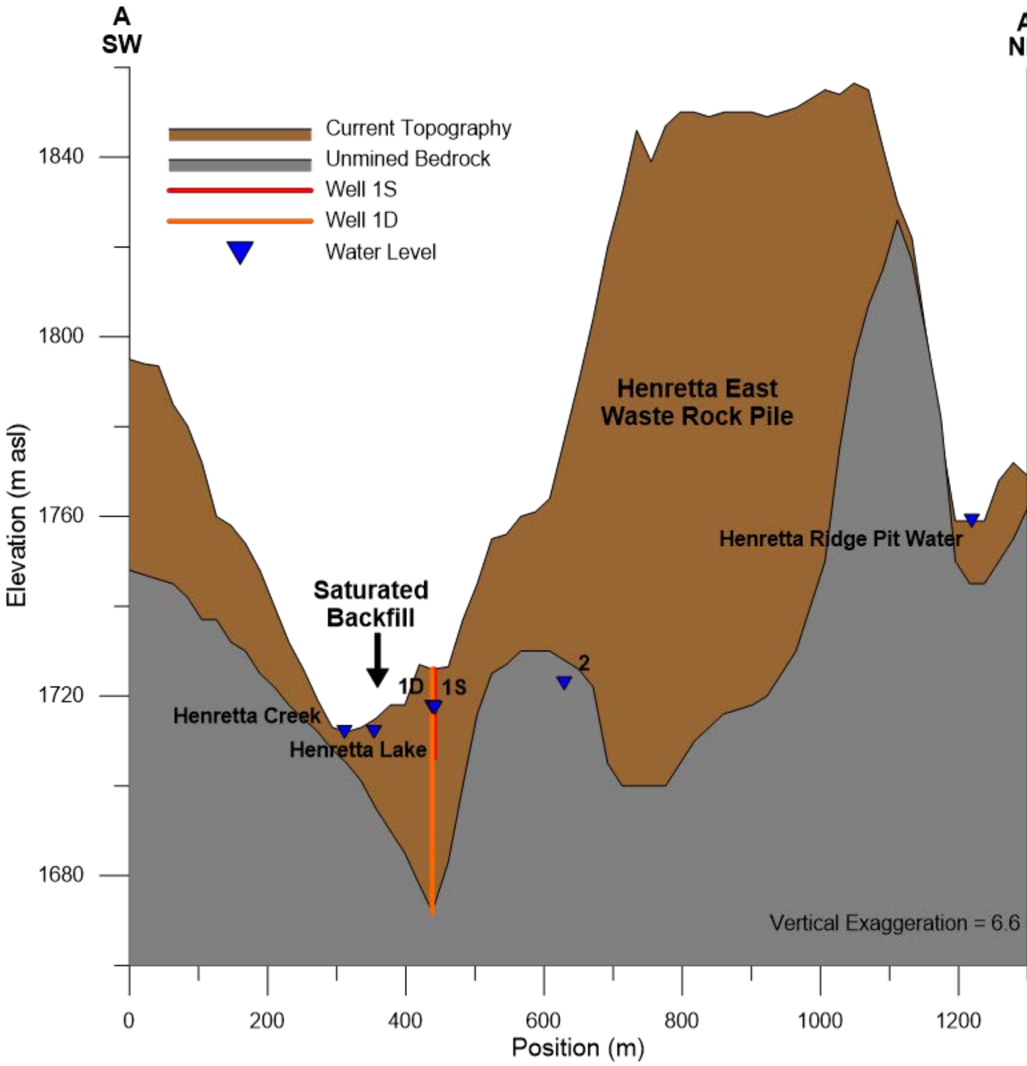

Figure 3.3. Schematic cross section along Section A-A' of the Henretta study area. The location of the cross section is shown on Figure 3.2 (white line). The water level '2' is estimated from Well 2, which is located approximately 180 m to the east of the cross section. Water levels '1D' and '1S' are mean measured water levels for Wells 1D and 1S for 2014.

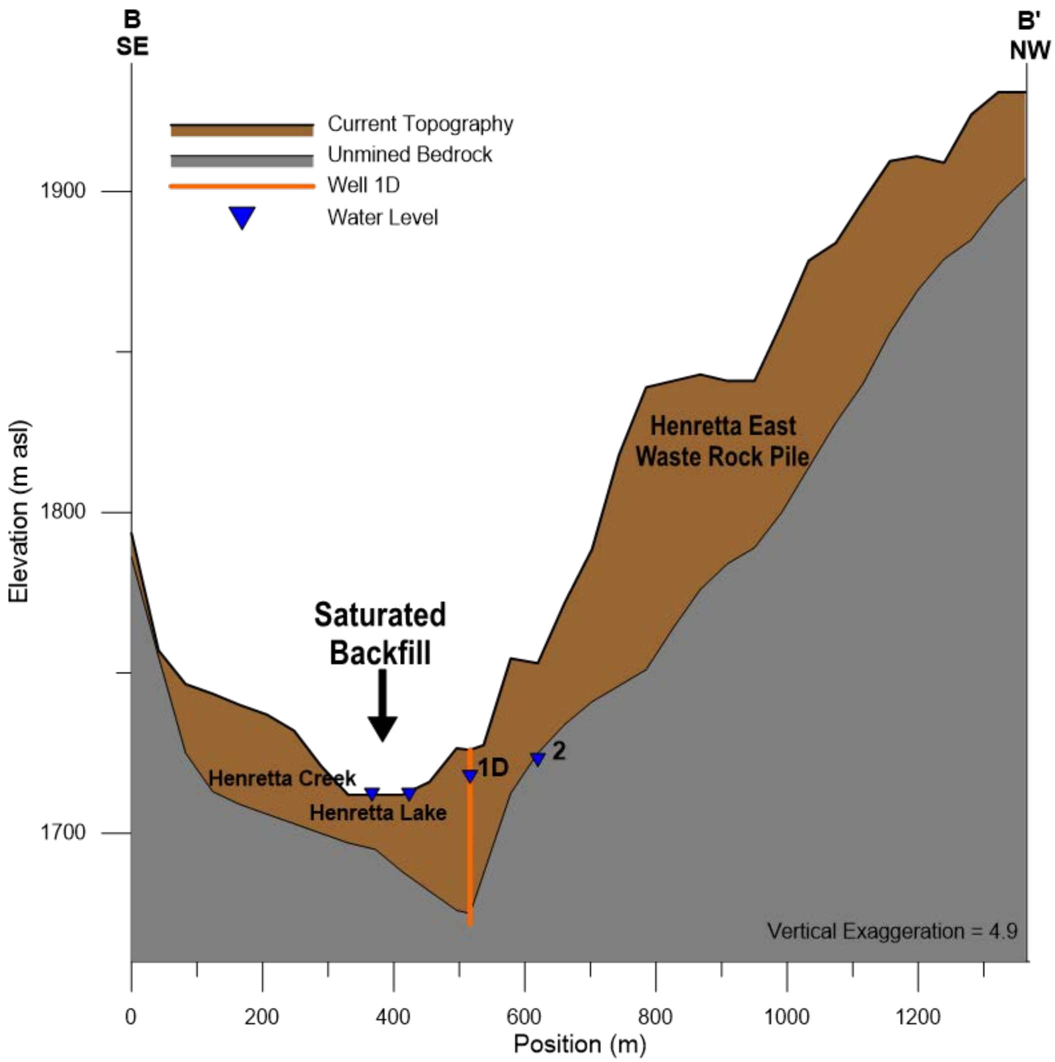

Figure 3.4. Schematic cross section along Section B-B' the Henretta study area. The location of the cross section is shown on Figure 3.2 (green line). The water level '2' is the measured water level from Well 2, which is located approximately 240 m to the east of the cross section. Water level '1D' is the mean measured water level for 2014.

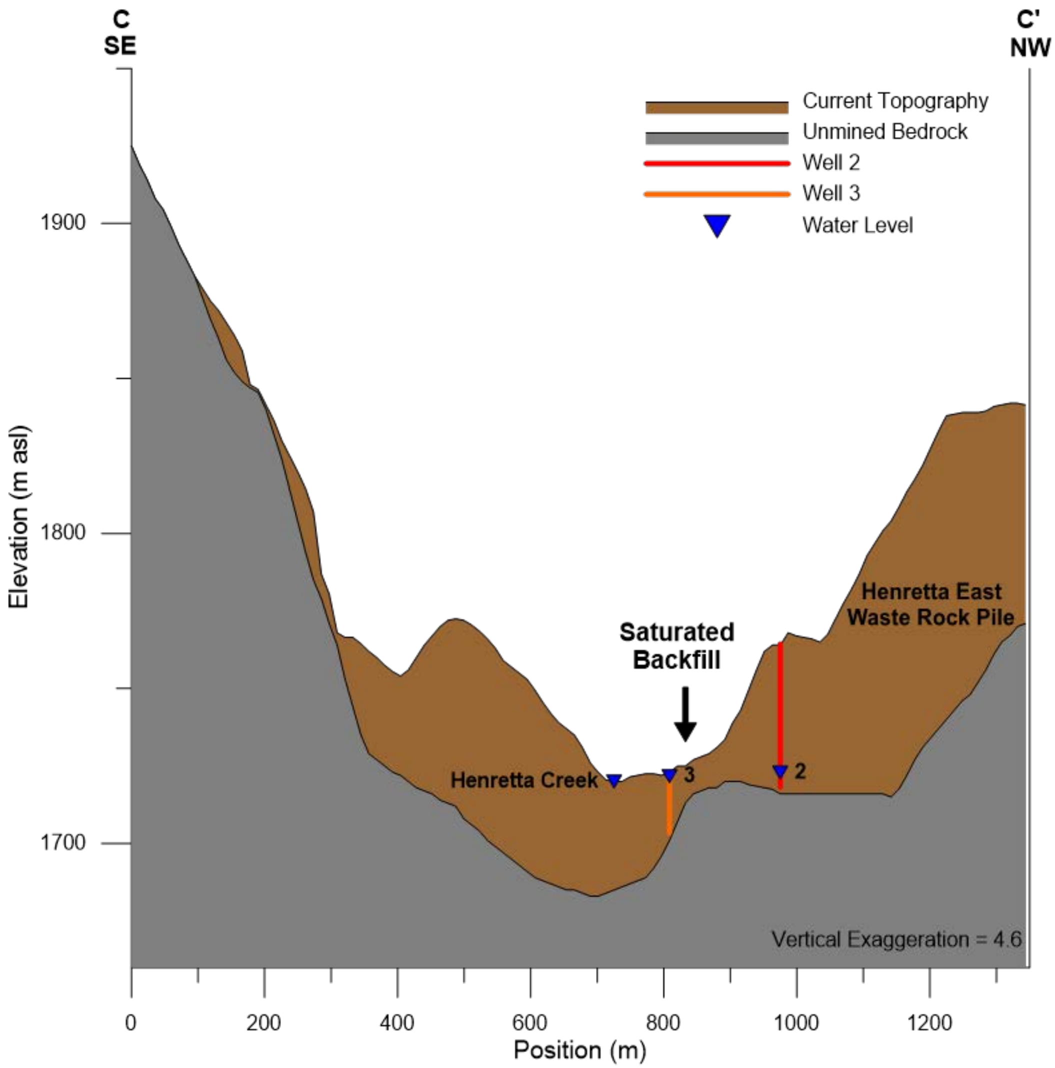

Figure 3.3. Schematic cross section along Section C-C' the Henretta study area. The location of the cross section is shown on Figure 3.2 (navy blue line). Water levels at Wells 2 and 3 are water levels measured on July 14, 2014.

3.1 Mining History at Study Area

The Henretta area was mined in the 1990s by truck-shovel pre-strip and drag-lining (Fording Coal Limited, 1991). Mining at this location extended below an elevation of 1660 m above sea level (asl), and the area has been partially backfilled with waste rock to a maximum backfill thickness of 60 m (Golder Associates Ltd., 2011). To the north of Henretta lake and creek is the Henretta East waste rock pile and the Henretta Ridge Pit (Figures 3.2 to 3.6). The Henretta Ridge Pit (Figure 3.3) is partially filled with water, and sumps are used to pump water from the pit into the Henretta East waste rock pile. The conceptual model for water migration starts with water infiltrating into the unsaturated waste rock pile until bedrock is encountered. Because the bedrock is orders of magnitude less permeable than the waste rock (Golder Associates Ltd., 2011), the majority of the water then migrates across the bedrock surface, resulting in flow down slope toward the backfilled pit (Golder Associates Ltd., 2011).

During mining, Henretta Creek was diverted through culverts to prevent flooding of the mining area and to decrease NO_3^- and sediment loading in the creek (Figure 3.6). After completion of mining in the area, a reclaimed channel for Henretta Creek was created adjacent to the diversion culverts (Figure 3.6). The reclaimed creek was created with the same grade and length as the original creek, and was constructed of waste rock. A liner was necessary beneath the reclaimed channel to prevent excessive losses to seepage. Henretta Lake was created after mining was completed, was designed to be maintained at an elevation of 1712 m asl, and allow for the settling of suspended solids from Henretta Creek (Fording Coal Limited, 1991).

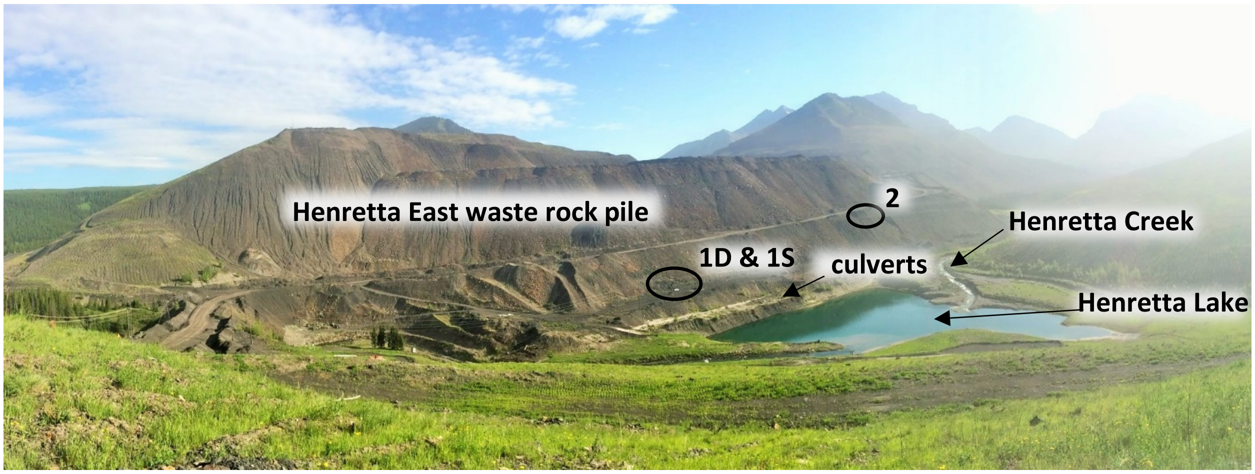

Figure 3.4. View of the study area looking NE.

3.2 Well Installation

Six monitoring wells were installed at five locations in the Henretta study area in August 2011 (Figure 3.2) (Golder Associates Ltd., 2011). A Barber rig (dual rotary) was used for drilling and installation of the wells. All boreholes have an outer diameter of 203 mm, with a 60.3 mm outer diameter/49.3 mm inner diameter riser pipe installed within the borehole. The pipe is Schedule 80 PVC pipe and screened for the bottom 3 m with 12-slot screen with the exception of Well 4 which has a screen length of only 1.5 m. A sandpack (10/20 silica sand) was installed along the length of the screen (in some cases extending beneath the bottom of the screen). Wells 1D, 1S, 2, and 3 have at least 3 m of sandpack extending upward from the top of the screen. Well 4 has 1.5 m of sandpack above the top of the screen, and Well 5 has 2.7 m. The annulus of the borehole above the sandpack is sealed with bentonite pellets followed by bentonite chips from the top of the seal to the ground surface. Construction details for each well are provided in Table 3.1 (Golder Associates Ltd., 2011). A levelogger was installed in each of the wells to monitor changes in water level over time.

Table 3.1. Details on monitoring well installation at Henretta study area (data from Golder Associates Ltd., 2011).

Well	Length of Sandpack (m)	Length of Seal (m)	Length of Grout (m)	Total Borehole Depth (m)	Well Depth (m)	Depth to Bedrock (m)	Ground Elevation (m asl)
1D	6.1	0.7	47.5	54.3	54.3	53.9	1732.2
1S	6.4	0.6	25.9	33.5	32.9	53.9	1732.3
2	9.7	6.1	30.2	48.8	46.3	47.7	1767.3
3	11	0.6	10.7	22.6	19.7	22.6	1728.2
4	3.2	0.2	2.1	8.2	5.3	5.5	1741.3
5	5.9	0.3	4.3	12.8	10.4	10.7	1785.2

Wells 1D and 1S were installed at the same location, approximately 4.5 m apart, and are located in the saturated backfill. Well 2 was installed at the intersection of the Henretta East waste rock pile and the backfill, and was installed to provide information on water quality prior to its entry into the backfilled pit (Golder Associates Ltd., 2011). Well 3 is located near the reclaimed Henretta Creek Channel, and was placed to intersect the base of the backfilled pits in the eastern portion of the Henretta Pit (Golder Associates Ltd., 2011). Well 4 is a shallow well installed in overburden to examine contributions from shallow groundwater. Well 5 is located upstream of the mining footprint to provide background water quality (Golder Associates Ltd., 2011).

3.3 Existing Hydraulic Data

Values of K for the backfilled pit were estimated by Piteau Associates (Holmes and Carriou, 1998) using the Hazen method and by Golder Associates Ltd.(2011) using falling and rising head slug tests and constant rate pumping tests in the six monitoring wells at Henretta. Values of K between 6×10^{-4} and 2×10^{-2} m/s were calculated from three samples of backfill material using the Hazen method. Results from Golder Associates Ltd. testing are provided in Table 3.2. They noted that, due to the high K of the backfilled pit, constant rate testing did not create enough drawdown for reliable analysis in Wells 1S, 1D, 2, and 3. At Well 1S, the water level response was too rapid to allow analysis of the rising and falling head slug tests (Golder Associates Ltd., 2011). These results suggest high K values in the saturated backfill. Bedrock K is likely orders of magnitude lower; a study by Szmigielski (2015) found a geometric mean K of 3.3×10^{-8} m/s for bedrock at a nearby site.

Table 3.2. Results of hydraulic conductivity testing at Henretta study area (Golder Associates Ltd., 2011).

Well	Slug Testing (m/s)	Constant Rate Pumping (m/s)
1D	1×10^{-4}	-
1S	-	-
2	3×10^{-3}	-
3	7×10^{-4}	-
4	1×10^{-3}	1×10^{-3}
5	3×10^{-3}	3×10^{-5}

4.0 MATERIALS & METHODS

Various activities were conducted at the Henretta study area in 2013 and 2014 to characterize the chemical and hydraulic properties of the saturated backfill. Details on the testing and sampling preformed are provided below.

4.1 Well hydraulic Tests

Water level measurements were made before sampling events and before push-pull tests (discussed below) using a Solinst® Water Level Meter (Model 101 P7). Changes in water level during push-pull tests were monitored with a Solinst® Levelogger (Model 3001 LT F30/M10, accuracy: ± 0.5 cm, resolution: 0.006 cm, sampling frequency: 0.5 seconds).

Pneumatic slug tests were chosen to provide a more rapid initiation of the test than a conventional slug test where the initial change in head is produced by adding or removing a solid slug of water (Butler *et al*., 1996). In pneumatic slug tests, air pressure is used to create the initial displacement of water in the riser. These tests were conducted on Well 1D on May 22 and July 16, 2014. A Solinst® Levelogger was placed below the water surface and a Solinst® Barologger (Model 3001 LT F5/M1.5, accuracy: ±0.1 cm, resolution: 0.003 cm, sampling frequency: 0.5 seconds) was placed in the well, above the water surface. The well was then sealed with a well cap, and an air compressor used to pressurize the well (initial displacements between 0.10 and 2.4 m) and depress the water surface. The cap was then rapidly removed, depressurizing the well, and the Levelogger (sampling frequency of 0.5 seconds) was used to monitor the recovery of water in the well. The Barologger (sampling frequency of 0.5 seconds) was used to monitor air pressure above the water surface in the well. These data were analysed using the Hvorslev method for L/R > 8 (Freeze and Cherry, 1979):

$$K = \frac{r^2 \ln(L/R)}{2LT_0} \quad . \tag{4.1}$$

where K is in [m/h], r is the radius of the well (0.02465 m), L is the intake length (length of sandpack, 6.1 m), R is the radius of the sandpack (0.1016 m), and T_0 is the basic time lag [h]. The L/R for Well 1D is 9.4, making the L/R > 8 assumption for the formula valid. The value for T_0 was read off of a semi-log plot of normalized head versus time at 0.37 on the normalized head (y) axis. Normalized head was calculated as the deviation from static at given time divided by the initial displacement. The initial displacement was obtained from the change in pressure (measured by a barologger) that initiated the test.

The method presented in Butler *et al.* (2003) was also used to interpret the pneumatic slug tests. This method was specifically developed for high K formations and, for unconfined aquifers, uses an extension of the Bouwer and Rice (1976) method. An Excel spreadsheet (obtained from Butler and Garnet, 2000) was used to analyze the pneumatic slug test data. Type curves generated from the damped spring solution are matched to plots of normalized deviation from static water level versus test time. The matches were obtained by changing the degree of oscillation and/or the period of the curve. The spreadsheet uses the degree of oscillation, period, and well information (e.g., diameter, intake length, water level, saturated thickness, and length of well) to calculate K. The 'Boundary' method presented by Butler (2003) was used for the analysis of Well 1D slug tests; the bottom of Well 1D intersects bedrock, which has a lower K value than the waste rock. The 'Boundary' method is intended for use where the well is screened up to an impermeable boundary, and although the bedrock is not impermeable, it has a significantly lower K value than the backfill material (Golder Associates Ltd, 2011). Initial displacement was determined from the change in pressure (from the Barologger) as recommended by Butler (2003). Butler *et al.* (1996) recommends that three or more tests be performed at each well, and so 5 tests were performed on both testing days at Well 1D.

4.2 Helium/Tritium Groundwater Dating

Samples for helium (^{3}He) / tritium (^{3}H) dating were collected from Wells 1D, 1S, and 3. The procedure for this method is described in detail by the Dissolved and Noble Gas Laboratory, University of Utah (http://www.noblegaslab.utah.edu/). Two 500 mL samples with no headspace were collected in LDPE bottles from each well. A PT4 Tracker Lumi4 was used to measure total dissolved gas pressure (mmHg), barometric pressure (mmHg), and water temperature in the well. Two copper tubes connected by a semi-permeable membrane were placed in the well and allowed time for equilibration with the dissolved gases in the well. The copper tubes were then removed from the well and cold-welded using a pinch off tool to seal the samples from the atmosphere (University of Utah, 2013).

4.3 Groundwater Sampling

Groundwater samples were collected for chemical analysis during push-pull tests and from discrete sampling events. For samples collected outside of push-pull testing, three well and sandpack volumes were purged from each well prior to sample collection. Both purging and sample collection were conducted using a Grundfos® submersible sampling pump (Grundfos Redi-Flo 2). The pump was rinsed with reverse osmosis water to minimize cross-contamination between wells. Samples were collected in 1 L HDPE bottles that were triple rinsed with sample water prior to sample collection. Sample water was then separated into individual sample bottles for different analysis. Procedures for sample analysis is provided in Table 4.1. All filtering was done in the field with disposable Whatman 0.45 µm polyethersulfone (PES) filters.

Table 4.1. Water sampling procedures for chemical analyses.

Analysis Type	Bottle	Filtration	Preservation	Storage
Nitrate Isotopes	60 mL HDPE	0.45 µm	None	Frozen
Selenium Speciation	20 mL Amber vial	0.45 µm	None	Frozen
Major Anions	20 mL LDPE	0.45 µm	None	Fridge
Major Cations and Select Trace Metals	30 mL LDPE	0.45 µm	2% v/v with HNO_3	Fridge
Water Isotopes	20 mL LDPE	0.45 µm	None	Fridge
DOC	60 mL HDPE	0.45 µm	None	Frozen

All samples were shipped to the Aqueous and Environmental Geochemistry Laboratory (AEL) at the University of Saskatchewan for analysis and/or storage. Blank samples of reverse osmosis water were submitted approximately every 30 samples, and duplicate water samples approximately every 10 samples.

4.4 Push-Pull Testing

The following paragraphs describe the method used for push-pull testing at Well 1D in 2014. Tests conducted at Well 3 in 2013 were conducted during method development, and the method used in those tests differ from methods presented below. Tests conducted at Well 3 in 2014 used methods similar to those presented below, but slight differences (e.g., number of samples collected for determination of background conditions) did occur. Slight changes in the method were required to reduce dilution (by way of removal of the clean water push following spike injection), and decrease uncertainty in background concentrations (through an increase from two to four background samples collected for each test).

During the injection and extraction phases, water quality parameters including temperature, specific conductivity, salinity, pH, ORP (oxidation-reduction potential), and luminescent dissolved oxygen (LDO) (accuracy and detection limits presented in section 4.5.1, below) were monitored using an OTT Hydrolab MS5. The Hydrolab was placed in a flow-through cell and connected to the sampling pump using HDPE tubing. Hydrolab measurements were recorded on a 1-minute sampling interval. A sampling port was placed in the tubing system (Figure 4.1) to facilitate water sampling. An Omega Turbine Flowmeter was connected to the tubing system to measure flow rate and total volume injected or extracted (± 2%). The outlet for the tubing system was simply an open portion of the tubing that was used to either dispose of purge water to ground, fill the holding tank, inject water into the well, or dispose of water into 1000 L totes for subsequent removal from site. Changes in water level were monitored throughout purging, injection, and extraction using a Solinst® Levelogger (Model 3001 LT F30/M10, accuracy: ± 0.5 cm, resolution: 0.006 cm, sampling frequency: 0.5 seconds), placed below the water surface prior to the start of purging.

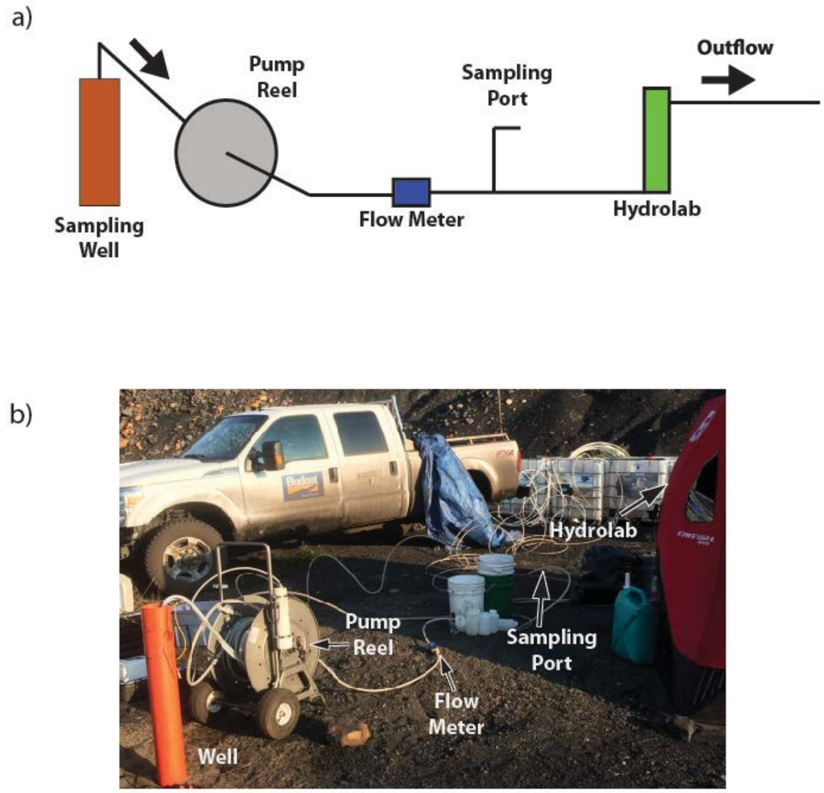

Figure 4.1. Schematic of the tubing system used in push-pull testing (a), and a picture of the tubing system set-up during push-pull testing (b).

Three well and sandpack volumes (approximately 500 L for Well 1D and approximately 560 L for Well 3) were purged prior to collection of water for the spike injection. After purging, water to be dosed with the tracers and re-injected into the test well was pumped into a 1200 L holding tank. During tank filling (duration of roughly 1.8 h), four water samples were collected to establish pre-test (background) geochemistry. Field alkalinity, pH, and Cl^- concentration were measured on the collected samples. Maintaining low DO concentrations was necessary as pre-test DO concentrations were measured to be below detection (resolution = 0.01 mg/L). As such, the tests using Se and/or NO_3^- as reactive tracers required the spike water to be devoid of oxygen. This was accomplished by displacing the oxygen in the holding tank with argon gas prior to filling. The argon gas was also used to sparge the spike water during filling of the holding tank and during well injection. In the test in which DO was the reactive tracer, an air compressor was used to sparge atmospheric air through the spike water to saturate the water with DO. Concentrations of DO for both cases (with or without argon) were measured in the tank using a Hach Luminescent Dissolved Oxygen Probe (accuracy: ±0.1 for 0 to 8 mg/L, ±0.2 for >8 mg/L, range: 0.1 to 20.0 mg/L) and in-line using the Hydrolab (accuracy: ±0.1 for 0 to 8 mg/L, ±0.2 for 8 to 20 mg/L, range: 0 to 60 mg/L).

The conservative and reactive tracers (other than DO) were premixed in a 10 L container and added to the tank as it was filled. After the tracers were thoroughly mixed in the holding tank and the desired volume of formation water added to the tank, the pump was removed from the well and placed in the tank where it was used to pump the spiked water into the well. During spike injection, samples were collected after approximately every 100 L of injected spike water. Five samples were taken for full geochemical analyses (all samples listed in Table 4.1) and field alkalinity, pH, and Cl^- concentration measurements (called 'full samples'). Six additional samples were collected for major anions and cations, select trace metals, and isotopes of water (called 'partial samples'). A DO reading was made in the tank using the Hach Luminescent Dissolved Oxygen Probe when both full and partial samples were collected.

The injection phase was complete when approximately 1000 L of spiked water was injected into the well. The tubing and levelogger were then removed from the well and the spiked water was left in the formation and well for a predetermined time period (reaction time) (Table 4.2) before commencing the extraction of the spike. The duration of the reaction time was varied depending on the amount of dilution observed in earlier tests. It was necessary to extract water which still has elevated (above background) concentrations of the tracers for laboratory measurements and data analysis, but longer reaction times were desirable to allow for more time for *in situ* reactions to occur.

After the desired reaction time was complete, the pump was placed in the screened portion of the well and the extraction phase commenced. Samples for geochemistry were collected every 15 minutes for the first four hours and every 30 minutes for the remainder of the extraction phase. The first samples were taken after approximately 30-40 L of water was extracted. Geochemistry samples alternated between full samples and partial samples. Where full samples were collected, field alkalinity, pH, and chloride (Cl^-) concentration were also measured. As with the injection phase, the Hydrolab was used to take measurements of temperature, specific conductivity, salinity, pH, ORP, and LDO each minute. The extraction phase lasted for 8 h.

A total of eight push-pull tests were conducted on Well 3 from September 2013 to August 2014; four in 2013 and four in 2014. Two push-pull tests with aerated water only (spiked with DO, but no other tracer), and one push-pull test with Cl^- and deuterium (δD) as conservative tracers, but no reactive tracer, were performed in 2013 as part of method development. Data for these tests are provided in Appendix D, but are not discussed further in this thesis. The final push-pull test conducted at Well 3 in 2013 used both conservative tracers (Cl^- and δD) and a reactive tracer (DO). In this test, 450 L of spiked water was injected into the formation. Following the injection of the spike, approximately 165 L of unspiked well water was injected into the well to push the spiked water out of the well and sandpack and into the formation. The spike solution was allowed to remain in contact with the formation overnight (reaction time of 18.3 h), and extraction commenced the following morning.

Four additional tests were conducted at Well 3 between June 13 and July 30, 2014. All of these tests used Cl^- and δD as conservative tracers but with the following reactive tracers and reaction times: (1) Se and 91.6 h, (2) NO_3^- and 67.1 h, (3) Se and NO_3^- and 43.3 h, and (4) DO and 18.6 h. High levels of dilution, potentially due to the proximity of Well 3 to Henretta Creek and elevated creek levels from snow melt, led to low recoveries of both conservative and reactive tracers from all four tests conducted at Well 3 in 2014. Low tracer recovery resulted in normalized concentrations near 0 and scatter in the plots of normalized concentration versus time. Due to this scatter, comparisons between conservative and reactive tracer trends were difficult to make and limited data interpretation.

Testing was then moved to Well 1D which is deeper than Well 3 and has a thicker saturated zone (Figure 3.2). Push-pull testing was relocated to this well in an attempt to decrease dilution during testing and furthermore it was thought that the thicker saturated zone at Well 1D would result in stronger reducing conditions and therefore greater likelihood of Se and/or NO_3^- reduction. Well 1D frequently had the lowest Se/SO_4^{2-} concentration ratios of the wells sampled at Henretta, indicating that if Se reduction is occurring at Henretta, Well 1D is the most likely location at which to observe it. The focus of this thesis will be on tests conducted at Well 1D; these tests are described below.

Three push-pull tests were conducted at Well 1D in August of 2014. All tests used both Cl^- and δD as conservative tracers. The reactive tracers used were DO, Se^{6+}, and NO_3^-. The reactive tracers used in each test and their concentrations, along with the reaction time (reaction time of the spiked water in the formation), volume injected, injection duration, volume extracted and extraction duration are presented in Table 4.2. Timing and rates of injection/extraction are provided in Table 4.3.

Table 4.2. Testing schedule for push-pull tests conducted at Henretta Well 1D in 2014.

Test	Reactive Tracers	Reaction Time (h)	Volume Injected (L)	Injection Duration (h)	Volume Extracted (L)	Extraction Duration (h)	Average Spike concentration/value
1	DO	19.0	994	1.6	2954	8.0	Cl: 637 mg/L
							δD: -49‰
							DO: 10.9 mg/L
2	SeO_4^{2-}	66.9	1005	1.8	3187	8.0	Cl: 709 mg/L
							δD: -45‰
							SeO_4^{2-}: 0.91 mg/L (as Se)
3	SeO_4^{2-}, NO_3^-	65.9	910	2.0	2998	8.1	Cl: 733 mg/L
							δD: -53‰
							SeO_4^{2-}: 0.90 mg/L (as Se)
							NO_3^--N: 357 mg/L

Table 4.3. Timing and rates of injection and extraction for push-pull tests conducted at Well 1D in 2014.

Test	Injection Date	Injection Rate (L/min)	Extraction Date	Extraction Rate (L/min)
1	August 6	10.4	August 8	6.1
2	August 15	9.4	August 18	6.6
3	August 22	7.6	August 25	6.2

4.5 Sample Analysis

Instruments and methods used to measure parameters in the field and laboratories are described below.

4.5.1 Field Analysis

A Hydrolab MS5 multiparameter mini sonde from OTT Hydromet was used to take in-line measurements. The measurements and their respective range, accuracy, resolution, and calibration are provided in Table 4.4 below. In addition to measurements with the Hydrolab, measurements of pH, temperature, alkalinity, and Cl^- concentration were made on geochemistry samples as they were collected. An Oakton hand held pH meter (110 Series) was used to measure the pH (±0.01 pH units) and temperature (±0.5 °C). This meter was calibrated daily with pH buffer solutions 4.01, 7.00, 10.01. Field alkalinity was measured on unfiltered samples using a Hach Alkalinity Test Kit (Model AL-DT, range: 10 to 4000 mg/L as $CaCO_3$) in conjunction with the Oakton hand held pH meter.

A Thermo Scientific Orion Star A221 in conjunction with a Thermo Scientific Combination Chloride Electrode (average relative percent difference (RPD) on duplicate samples was 6.3% (n=15), resolution: 0.01 mg/L) was used to take field measurements of Cl^- concentrations. This probe was calibrated with a three-point calibration, using a high and low standard that bracketed the expected sample Cl^- concentration range.

Table 4.4. Details on Hydrolab measurement capabilities and calibration.

Measurement	Range	Accuracy	Resolution	Calibration
Dissolved Oxygen	0 to 60 mg/L	±0.1 mg/L at ≤ 8 mg/L ±0.2 mg/L at 8–20 mg/L	0.01 mg/L	100% Saturation at room temperature
Specific Conductance	0 to 100 mS/cm	±(1% of reading + 0.001 mS/cm)	0.0001 mS/cm	Two point calibration, with dry sensor for 0 reading and 1 standard
pH	0 to 14 pH units	±0.2 pH units	0.01 pH units	4.01, 7.00, and 10.00 pH buffers
ORP	-999 to 999 mV	±20 mV	1 mV	Zobell’s Solution
Temperature	-5 to 50 °C	±0.1 °C	0.01 °C	Factory Calibration

4.5.2 Ion Chromatography

Ion chromatography (IC) was used for major anion analysis, and this analysis was conducted at the AEL, University of Saskatchewan. Samples were field filtered through a 0.45 μm filter and stored at 4°C in 20 mL LDPE scintillation vials with polyethylene cone liner caps. A Dionex ICS-2100 coupled to a Dionex AS-AP autosampler was used for sample analysis. The exchange column used was a Dionex IonPac AS9-HC 2×2 mm, and the eluent was 9.00 mM K_2CO_3. Constituents analyzed and detection limits are provided in Table 4.5 below. Precision and accuracy for this method are within 5% (Nelson, 2014).

Table 4.5. List of constituents and detection limits for IC analysis.

Constituent	Method Detection Limits
F^-	0.05 mg/L
Cl^-	0.05 mg/L
NO_2^-	0.05 mg/L N
Br^-	0.2 mg/L
NO_3^-	0.03 mg/L N
PO_4^{3-}	0.05 mg/L PO_4^{3-}
SO_4^{2-}	0.05 mg/L SO_4^{2-}

4.5.3 Inductively-Coupled Plasma Optical Emission Spectrometry

Inductively-coupled plasma optical emission spectrometry (ICP-OES) was used for major cations and select trace metal analysis. Analysis was conducted at the AEL, University of Saskatchewan. Samples were field filtered through a 0.45 μm filter and stored in 30 mL LDPE bottles. Samples were preserved with 2% volume/volume nitric acid and stored at 4°C. A SpectroBLUE ICP-OES coupled to a CETAC ASX-520 autosampler was used for sample analysis. Constituents analyzed and detection limits are provided in Table 4.6 below. Precision and accuracy for this method are within 5% (Nelson, 2014).

Table 4.6. Constituents analyzed and detection limits for ICP-OES analysis.

Constituents	Method Detection Limits
Ca	0.019 mg/L
Mg	0.004 mg/L
Na	0.003 mg/L
K	0.0009 mg/L
P	0.004 mg/L
S	0.018 mg/L
Se	0.004 mg/L
Cd	0.0003 mg/L
As	0.004 mg/L

4.5.4 High Performance Liquid Chromatography Inductively-Coupled Plasma Mass Spectrometry

Select samples were analysed by high performance liquid chromatography inductively-coupled plasma mass spectrometry (HPLC-ICP-MS) at the AEL, University of Saskatchewan, for determination of Se speciation. Samples were field filtered through a 0.45 µm filter into 20 mL amber vials and frozen. Analysis was conducted on a PerkinElmer Flexar HPLC system and NexION 300D ICP-MS. Isotopes ^{78}Se and ^{82}Se were measured to determine concentrations of Se^{4+} and Se^{6+}. Results from ^{82}Se measurement were used for data analysis as there was less interference than the results from ^{78}Se measurement. The minimum detection limit is 1 ppb, and the precision and accuracy are within 15% (Nelson, 2014).

4.5.5 Stable Isotopes of Water

Samples for analysis of stable isotopes of water were analyzed at the AEL, University of Saskatchewan. Samples were field filtered through a 0.45 µm filter and collected, with no headspace, in 20 mL LDPE scintillation vials with polyethylene cone liners in the caps. These samples were analyzed on a Picarro isotope analyzer (Picarro L2120-I isotopic water liquid analyzer) using the $H_2O_{(liquid)}$-$H_2O_{(vapour)}$ equilibration method described in Wassenaar *et al.* (2008) and Hendry *et al.* (2015). Accuracy for this method was better than ±0.4‰ for $\delta^{18}O$ and ±2.1‰

for δD relative to VSMOW. All δD and $\delta^{18}O$ values are reported relative to VSMOW. Accuracy is determined from laboratory standards and analysis of replicate samples.

4.5.6 Nitrate Isotopes

Six water samples were analyzed for NO_3^- isotopes at the Isotope Science Laboratory, University of Calgary. Samples were field filtered through a 0.45 μm filter into a 60 mL HDPE bottle and frozen. The isotopic values of both nitrogen and oxygen were determined using the 'denitrifier method'. This method uses bacterial reduction of NO_3^- to nitrous oxide and is described in detail by the Isotope Science Laboratory (University of Calgary, 2014; http://www.ucalgary.ca/uofcisl/techniques). One sample from each of Wells 1S, 1D, and 3 collected on September 11, 2013, and one from each of the same wells collected on May 22, 2014 were submitted for analysis.

4.5.7 Dissolved Organic Carbon

Select samples for DOC were submitted to Saskatchewan Research Council Environmental Analytical Laboratory in Saskatoon, Saskatchewan for analysis. The method used is described in Standard Methods for Examination of Water and Wastewater, Section 5310C. This method involves the oxidation of the organic carbon to produce carbon dioxide, which is detected and measured by an infrared detector. The oxidation is activated by ultraviolet radiation in a persulfate solution (American Society for Testing and Materials, 1994). The detection limit is 0.2 mg/L, and error is between 0.3 and 0.4 mg/L (error is provided for each sample).

Three samples were submitted for each push pull test: (1) a background sample which was collected after purging, during the filling of the holding take, (2) a spike sample which was collected at approximately 700 L injected, and (3) a sample at the end of extraction that was collected after approximately 8 h of pumping during the extraction phase. Two samples were collected prior to push-pull testing at Well 1D on July 14, 2014. These samples were collected at the same time (duplicate sample) after approximately 500 L had been purged from the well.

4.6 Data Analysis

Normalized concentrations for each of the tracers were calculated to allow direct comparisons between tracers during extraction. Concentrations of tracers were normalized using:

$$C/C_0 = \frac{(C_t - C_B)}{(C_S - C_B)}. \tag{4.2}$$

where C/C_0 is the normalized concentration for a particular tracer, C_t is the concentration [mg/L] at time t, C_B is the average (n=4) background (i.e., formation) concentration [mg/L], and C_s is the average (n=4) concentration of the spike [mg/L]. The normalized concentrations of the conservative tracers (Cl^- and δD) were used to quantify loses due to dilution through advection, mechanical dispersion, and diffusion. Any additional losses observed in normalized reactive tracers (DO, Se^{6+}, and NO_3^-) were attributed to reactions occurring in the formation.

Two methods were used to quantify the potential error in the normalized concentration plots; a propagation of errors of precision calculation (Harrison, 2004) and a range of minimum and maximum values for each tracer during the extraction phase. For the propagation of errors of precision calculation, error due to the addition or subtraction of values was calculated using:

$$\Delta(A \pm B) = \sqrt{\Delta A^2 + \Delta B^2}. \tag{4.3}$$

where ΔA is the error in A, ΔB is the error in B, and Δ(A±B) is the error in the sum or difference in A and B. For multiplication and division, error was calculated using:

$$\Delta\left(\frac{A}{B} \text{ or } AB\right) = \left|\frac{A}{B} \text{ or } AB\right| \times \sqrt{(\frac{\Delta A}{A})^2 + (\frac{\Delta B}{B})^2}. \tag{4.4}$$

where ΔA is the error in A, ΔB is the error in B, and $\Delta\left(\frac{A}{B} \text{ or } AB\right)$ is the error in either the division or multiplication of A and B. Equations 4.3 and 4.4 were used to calculate the error in Equation 4.2 using the average values of C_S and C_B and the value of C_t for each time during extraction. The errors in the average values of C_s and C_B were either 5% (or 2.1‰ for δD) of their value (machine error) or the standard error between the four measured values used to calculate the average value, whichever was higher. This method was employed to quantify the overall error in the normalized concentration values from machine error. The error range was calculated by using the measured C_t value for each time during extraction, but instead of using the average values for C_S and C_B, minimum and maximum values were used to find the possible range of normalized values from the four measured values of both C_s and C_B. This method was employed to examine how the different measured values of C_s and C_B would affect the calculated normalized concentration.

Percent recovered for each species of each push-pull test was calculated as the mass recovered during extraction as a percent of the total mass injected. The mass recovered was calculated between each sample from the average concentration between two consecutive samples during extraction minus the background concentration, multiplied by the difference in volume extracted for the two samples. This procedure was applied to each of the samples during extraction, and the results summed. This summation was then divided by the mass of the spike injected. The mass of spike injected was calculated from the average spike concentration minus the average background concentration multiplied by the volume of spike water injected.

4.6.1 Pourbaix Diagrams

Pourbaix (Eh-pH) diagrams were prepared using The Geochemist's Workbench (Student Version 10.0.4). The extended Debye-Hückel equation was used to calculate the activity coefficient of Se^{6+} (and NO_3^- for Test 3) for each sample (Appelo and Postma, 2005):

$$\log\gamma_i = -\frac{Az_i^2\sqrt{I}}{1+B\mathring{a}\sqrt{I}}. \tag{4.5}$$

where γ is the activity coefficient of species i, A [unitless] and B [m^{-1}] are temperature constants, I is the ionic strength, and å [10^{-10} m] is the empirical ion-size parameter. Ionic strength was calculated using (Appelo and Postma, 2005):

$$I = {}^{1}\!/_{2}\sum m_i z_i^2. \tag{4.6}$$

where m is the molality of ion i and z is the charge number of i.

4.6.2 Geochemical Modelling

PHREEQC (Parkhurst and Appelo, 1999) geochemical modelling was used to define mineral saturation indices (SI) for gypsum using temporal geochemistry data. If the SI is equal to 0, equilibrium between the mineral and the solution is expected. Values of SI greater than 0 indicate supersaturation, where precipitation is expected, whereas values less than 0 indicate undersaturation and dissolution is expected (Appelo and Postma, 2005). Measured values of pH, temperature, and alkalinity for each sample were input into PHREEQC as well as the concentrations of the chemicals listed in Table 4.7 below. Where concentration data was missing for a particular sample, the mean value was used (Table 4.7).

Table 4.7. Elements used for geochemical modelling and their mean concentrations for the sampling period (n = 12).

Element	Mean Concentration (mg/L)
Al	0.0228
B	0.0524
Ba	0.01651
Ca	531
Cl	4.11
Fe	0.1124
K	8.66
Li	0.0823
Mg	274
Mn	0.541
N(-3) (NH_4^+)	0.613
N(+5) (NO_3^-)	162.1
Na	3.01
Ni	0.0341
P	0.00634
S(+6) (SO_4^{2-})	1589
Se	0.0587
Si	2.35
Sr	0.360
U	0.01147

4.6.3 Estimates of First-Order Reaction Coefficients

Estimates of k were determined using the simplified method of analysis for push-pull test data from Haggerty *et al.* (1998) (Equation 2.5). This method does not require details of aquifer properties, and assumes a well-mixed spike solution in the area of the aquifer being investigated.

Equation 2.5 is in the form of an equation of a straight line (y = mx + b), where k is the slope (m) in a plot of $\ln(C_r^*/C_c^*)$ versus t^*. The LINEST function in Microsoft Excel was used to fit a straight line to the data using the least squares method, generating a value for the slope of the line, and thus an estimation of k.

Schroth and Istok (2006) present a modified version of Haggerty's method. Instead of assuming a well-mixed solution, they provide a solution for a plug-flow model, where the first particle injected is the last extracted. A residence time for each particle is calculated from (Schroth and Istok, 2006):

$$t_{r,pf}^{j} = t^{*j} + \frac{\int_{t_{ext}=0}^{t_{ext}^{j}} Q_{ext} C_c(t)\,dt}{M_c} T_{inj}. \qquad (4.8)$$

where $t^{j}_{r,\,pf}$ is the plug flow residence time for particle j [h], $t^{*\,j}$ is the time elapsed since the end of the injection for particle j [h], Q_{ext} is the extraction pumping rate [L/h], $C_c(t)$ is obtained from fitting an exponential trendline to a plot of Cl^- concentration [mg/L] versus time elapsed since start of extraction [h], M_c is the mass of conservative tracer injected [mg], and T_{inj} is the duration of the injection phase. An estimate of k is then obtained using Equation 2.6. Note that the form of this equation (2.6) has b (y-intercept) equal to 0. The LINEST function in Microsoft Excel was used to fit a straight line to the data using the least squares method and forcing the line through 0 at the y-axis, generating a value for the slope of the line, which is k.

An additional estimate of k was determined using the first-order rate equation (Appelo and Postma, 2005):

$$C/C_0 = e^{-kt}. \qquad (4.10)$$

Equation 4.10 was used to calculate the normalized concentration of the reactive tracer for a given k at each time during extraction. The time was since the end of injection [h]. This value was then multiplied by the dilution factor [dimensionless] from a conservative tracer at the same time. The value of k was adjusted until the normalized concentration generated matched the normalized concentration at the reading before the reactive tracer concentration returned to background concentration. Although this method does not match the shape of the decay, it provides an estimate of the value of k necessary to consume the reactive tracer in duration of time from the end of injection to the point during extraction when the reactive tracer returned to background conditions.

5.0 RESULTS

Results of hydraulic testing (K testing, water level), age dating samples, push-pull tests, Se speciation sampling, isotope sampling, and DOC sampling are presented and discussed in this section. Interpretation of these results in context of the hydrogeologic system and the geochemistry monitoring is presented in Section 6.

5.1 Well Hydraulics

Testing was conducted on Well 1D to assess the hydraulics in the vicinity of the well screen. Both slug testing to determine K (Section 5.1.1) and water level measurements (Section 5.1.2) were conducted.

5.1.1 Slug Testing

Pneumatic slug tests were analysed using both the Hvorslev and Butler methods. Results obtained from these methods are provided in Table 5.1. An example of the curve matching used to obtain an estimate for K using the Butler method is shown in Figure 5.1.

Table 5.1. Results of slug testing at Well 1D.

Test	Initial Displacement (m)	Hvorslev Method K (m/s)	Butler Method K (m/s)
May 22, #1	0.57	7×10^{-5}	8×10^{-5}
May 22, #2	2.4	6×10^{-5}	7×10^{-5}
May 22, #3	1.7	5×10^{-5}	7×10^{-5}
May 22, #4	1.3	6×10^{-5}	7×10^{-5}
May 22, #5	2.2	6×10^{-5}	7×10^{-5}
July 16, #1	1.1	8×10^{-5}	8×10^{-5}
July 16, #2	1.1	6×10^{-5}	8×10^{-5}
July 16, #3	NM	-	-
July 16, #4	NM	-	-
July 16, #5	0.10	9×10^{-5}	9×10^{-5}

NM- No initial displacement was measured for tests #3 and #4 on July 16 due to a lack of pressurization of the well casing.

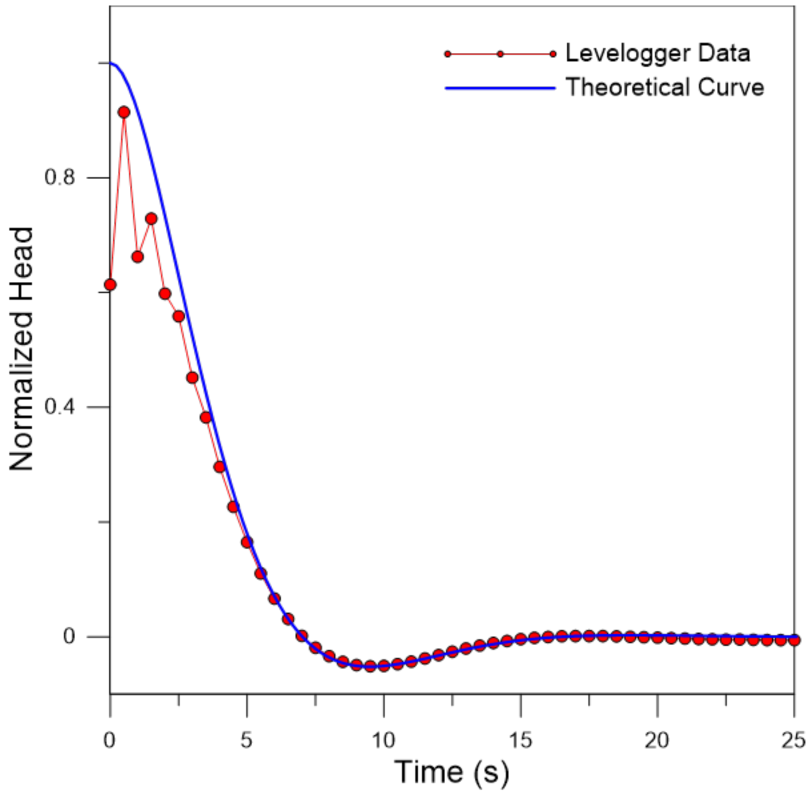

Figure 5.1. Normalized head versus time from Test #3 conducted May 22, 2014 (red) and theoretical curve generated from the Butler impermeable boundary method (blue) (Butler and Garnet, 2000).

Normalized plots of head for slug tests performed at the same well should yield similar results (Butler, 1996). The normalized heads of five tests performed at Well 1D on May 22, 2014 are not consistent (Figure 5.2). These differences indicate that the calculated K values are dependent on the initial displacement, possibly due to the mobilization of fines or alteration of the sandpack during testing (Butler *et al*., 1996). Despite the effect of initial displacement, calculated K values vary little (Table 5.1).

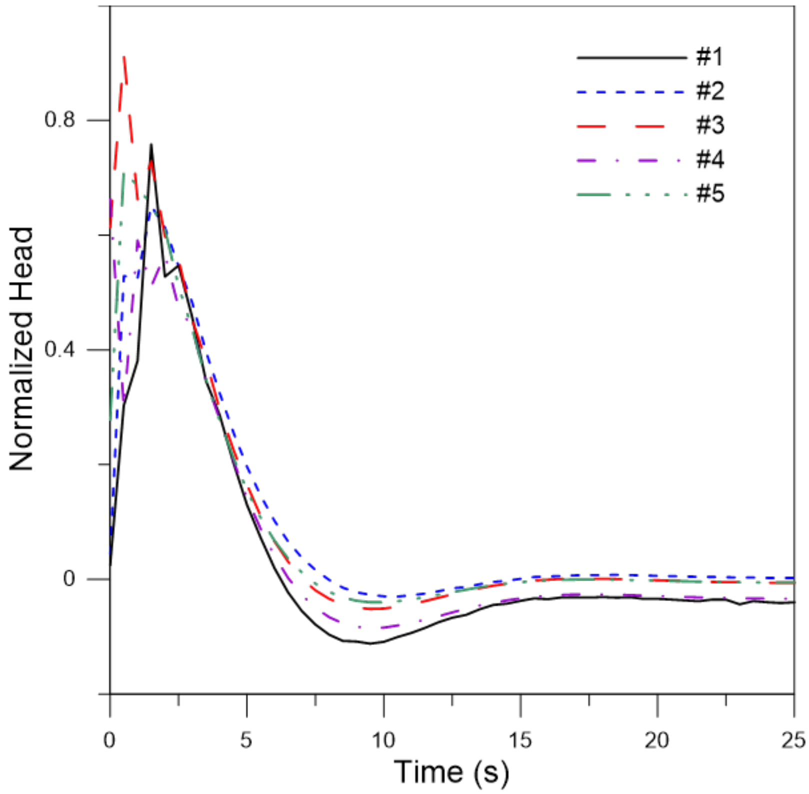

Figure 5.2. Normalized head versus test time for all five tests performed on Well 1D on May 22, 2014 (Tests from July 16 not presented).

With the exception of Test 1 from May 22 and Test 5 from July 16 (Table 5.1), the initial displacements were over 1 m. Smaller initial displacements were attempted, but often resulted in no measureable pressure response in the well casing (e.g., Tests 3 and 4 from July 16; Table 5.1). Small initial displacements are desirable to minimize the impact of frictional losses within the well (Butler, 2004). The equipment used did not allow for precise control over the air pressure being injected into the well, or for a reliable seal to prevent pressure loss. The large initial displacements also meant that it was necessary to place the levelogger approximately 3 m below the water surface. Placement of the levelogger as near to the water table as possible is recommended by Butler *et al.* (2003) to minimize effects of water column acceleration on the levelogger readings.

A limitation on the slug test method is that it only investigates a small volume around the well screen, as opposed to larger scale testing (e.g., constant rate pumping test with multiple observation wells). Both the differences in the normalized plots for the same well, and the procedural difficulties (e.g. large initial displacements/potential loss of pressurization) decrease the accuracy of results. Despite these limitations, the range of K values is small, ranging from 5×10^{-5} to 9×10^{-5} m/s, and suggest that the K estimates are useful to define the K at Well 1D.

The geometric mean K value for the testing performed at 1D in 2014 is 7×10^{-5} m/s for the Hvorslev method and 8×10^{-5} m/s for the Butler method. These values represent a minimum estimate of K, as these methods do not account for any additional head loss across the sandpack, which may be an important factor given the high K of waste rock. The average percent difference between the two methods for each test was 17%, with the Butler method yielding a higher estimate for each test. Butler *et al.* (2003) states that the Hvorslev method commonly yields overestimations of K by a factor of 1.9 for oscillatory responses, and ~13% for nonoscillatory responses. Response data for Well 1D is oscillatory, but close to critically damped. The use of the radius of the sandpack as R in the Hvorslev equation (as opposed to the radius of the screen) resulted in K values calculated using the Hvorslev method that were 74% of the values calculated using the radius of the well screen.

The geometric mean K value from both methods are slightly lower than the result of Golder Associates Ltd. slug testing at Well 1D in 2011, which yielded a K value of 1×10^{-4} m/s, and lower than the range of estimates for K using the Hazen method (from Piteau Associates), which was 6×10^{-4} to 2×10^{-2} m/s for three samples of backfill material (Golder Associates Ltd., 2011; Holmes and Carriou, 1998). Smith *et al.* (2005) state that K values for saturated, non-cohesive, soil like waste rock piles are generally between 10^{-6} and 10^{-4} m/s, which is in agreement with the findings of this study. Values of K in the range of 10^{-4} m/s are typical for clean sand or gravel for unconsolidated material, or fractured rock (Freeze and Cherry, 1979).

5.1.2 Water Level Measurements

A statistical summary of water level measurements taken prior to each sampling or push-pull test are presented in Table 5.2. Measurements in 2013 were taken between August 16 and September 11, and measurements in 2014 were taken between May 22 and August 25.

Table 5.2. Statistical summary of water level measurements conducted at Well 1D in 2013 and 2014.

Year	Average m BGS	Minimum m BGS	Maximum m BGS	Standard Deviation m	n
2013	14.65	14.61	14.67	0.02	5
2014	14.72	14.53	14.80	0.10	9

These water depths indicate the presence of about 40 m of saturated waste rock at Well 1D, and that the top of the well screen is approximately 36.5 m below the water table.

5.2 Helium/Tritium Groundwater Dating

Groundwater ages from Wells 3 and 1S were < 1.04 and <1.40 years respectively. The sample collected from Well 1D could not be analysed because the sample contained excess He^4. The excess He^4 was attributed to either excess air in the sample, or a broken/incomplete seal of the copper sampling tubes. These age dates suggest that the residence time for water to reach the screen of these two wells following entry to the saturated ground water flow system is rapid and suggests either very short flow paths and/or high groundwater velocities.

5.3 Push-Pull Testing

Although the focus of push-pull tests analysis was on tests performed at Well 1D, the last (of four) tests conducted in 2013 at Well 3 and all four tests conducted in 2014 at Well 3 will be discussed briefly below. Tests conducted at Well 3 contributed to the overall method development for push-pull tests. Furthermore, two of the tests conducted at Well 3 used DO as the reactive tracer, and measureable reduction in DO occurred throughout the test duration. Detailed analysis of the tests performed at Well 1D is provided in Section 5.3.2.

5.3.1 Push-Pull Testing Conducted at Well 3

Normalized concentrations for the final push-pull test conducted at Well 3 in 2013 ranged between 0.10 and 0.12 for all three tracers (Cl^-, δD, and DO) at the onset of the extraction phase (A7, Appendix A). Following this initial sample, the normalized concentration of DO decreased more quickly than the conservative tracers, indicating it may have been consumed within the formation. A decay coefficient (k) value of 0.03 h^{-1} (i.e., a half-life of approximately 23 h) was calculated using the first-order reaction equation (Equation 4.10). Results of this test suggest that a push-pull test could be used to test for the attenuation of a reactive dissolved species in waste rock given that the residence time (relative to the rate of reaction) is sufficient to observe a loss in the reactive species concentration relative to that of a conservative species. The injection of unspiked well water to push the spiked water into the formation was discontinued in subsequent push-pull tests to decrease dilution and increase the recovery of tracers.

Only two background samples were collected in the first two tests conducted at Well 3 in 2014. Discrepancies between these two sets of analyses led to uncertainty in the background concentration, and therefore uncertainty in the normalized concentration calculations. Three background samples were analysed in Test 3, and for all subsequent tests four background samples were analysed. Unfortunately, the first three of four tests conducted at Well 3 in 2014 yielded recoveries near background concentrations (i.e., < 0.10 normalized concentration recovery for the first sample during the extraction phase). The final test conducted at Well 3 in 2014 had a much shorter reaction time (18.6 h) than the other tests conducted in 2014, but recoveries were still low (A8, Appendix A). This test used DO as the reactive tracer. In 2013, DO concentrations at Well 3 were below detection. In the final test of 2014, the average DO concentration of well water prior to spiking was 1.1 mg/L. Normalized DO concentrations initially decreased during extraction and were lower than the normalized conservative tracer concentrations. This trend is in agreement with the 2013 test conducted. After the initial decrease, the DO concentration was stable at approximately 1.3 mg/L, and at the end of extraction was approximately 1.4 mg/L. An estimate of k of 0.07 h^{-1} (half-life of approximately 10 h) was calculated using equation 4.10; although based on the changing DO concentrations, decay and dilution were not the only processes affecting the DO concentration. Water level measurements in Well 3 (A4, Appendix A) show that the water level was elevated prior to and throughout push-pull testing in 2014, likely a result of the spring freshet and elevated water levels in Henretta Creek. These water level rises could have resulted in the addition of oxygenated water, resulting in higher, and potentially more variable, DO concentrations than those measured in 2013. Low recoveries and variable background conditions at Well 3 resulted in scatter in the normalized concentration plots making comparisons between tracers difficult. Because of this, data analysis focused on the push-pull tests performed at Well 1D.

5.3.2. Push-Pull Testing Conducted at Well 1D

Concentrations and normalized concentrations for analysed samples collected during the extraction phase of Well 1D tests are shown in Figures 5.3 (Test 1), 5.6 (Test 2), and 5.8 (Test 3). Because water extracted from the well and sandpack is not representative of the formation, only samples collected after pumping one well and sandpack volume (157 L) were used. The volume of water in the well plus the volume of water in the sandpack was calculated assuming a porosity of the sandpack of 0.45. As such, the first sample collected (at approximately 30 L extracted) was not used for data analysis. Despite well purging it is not possible to determine if water extracted after the initial 157 L is formation water, or if there continued to be some contribution from the sandpack/well. For the purpose of this study, it was assumed that samples collected after 157 L are representative of the formation. The maximum difference in water level from the start of extraction to the end of extraction was 0.15 m, which results in a volume of 0.286 L in the riser. Because this volume is small compared to the volume extracted, contributions from the standing water in the well to the overall chemistry of the extracted water after the purge of 157 L are considered minimal. Assuming a porosity of 0.45 for the sandpack (Rice Engineering & Operating Ltd., 2007), the volume of water in the sandpack was approximately 80 L. Much of this water would be extracted at the onset of pumping, and after extraction of 157 L of water, it is expected that the sandpack water will have either been extracted or well mixed with formation waters.

5.3.2.1 Test 1

Samples collected during the filling of the holding tank (background) and the concentrations of the spiked water for Test 1 at Well 1D are provided in Table 5.3. Background water temperature, pH, ORP, and alkalinity were 4.7°C, 6.9, 318 mV, and 372 mg/L as $CaCO_3$ respectively. Spike water temperature, pH, ORP, and alkalinity were 9.8°C, 8.2, 346 mV, and 397 mg/L as $CaCO_3$ respectively.

Table 5.3. Results of background and spike sampling for Test 1 at Well 1D. Cl^- and δD are from laboratory analysis, DO measurements are from Hydrolab readings during testing.

Species, Stage	Average Concentration/Value	Standard Deviation	Number of Samples/Readings
Cl^-, Background	3.57 mg/L	0.15 mg/L	4
δD, Background	-146.2‰	2.1‰	4
DO, Background	0 mg/L	0 mg/L	55
Cl^-, Spike	635.8 mg/L	1.8 mg/L	4
δD, Spike	-36.7‰	5.7‰	4
DO, Spike	10.86 mg/L	0.41 mg/L	90

The first sample for analysis during the extraction phase was collected after 40 L of extracted water had passed through the tubing system (measured at the flow meter). Concentrations of tracers at the time of the first sample were: 560 mg/L, -62.1‰, and 1.87 mg/L for Cl^-, δD, and DO respectively, which results in normalized concentrations of 0.88, 0.77, and 0.17. This sample was not used for data analysis, as only 40 L had been extracted. The second sample, which was collected at an extracted volume of 169 L was assumed to be representative of water from the formation. Concentrations for Cl^-, δD, and DO at this sampling time were 370 mg/L, -91.2‰, and 0.58 mg/L, respectively, resulting in normalized concentrations of 0.58, 0.50, and 0.05, respectively. Water temperature, pH, ORP, and alkalinity were 6.5°C, 7.1, 383 mV, and 384 mg/L as $CaCO_3$ respectively. Normalized concentrations of the tracers are shown in Figure 5.3.

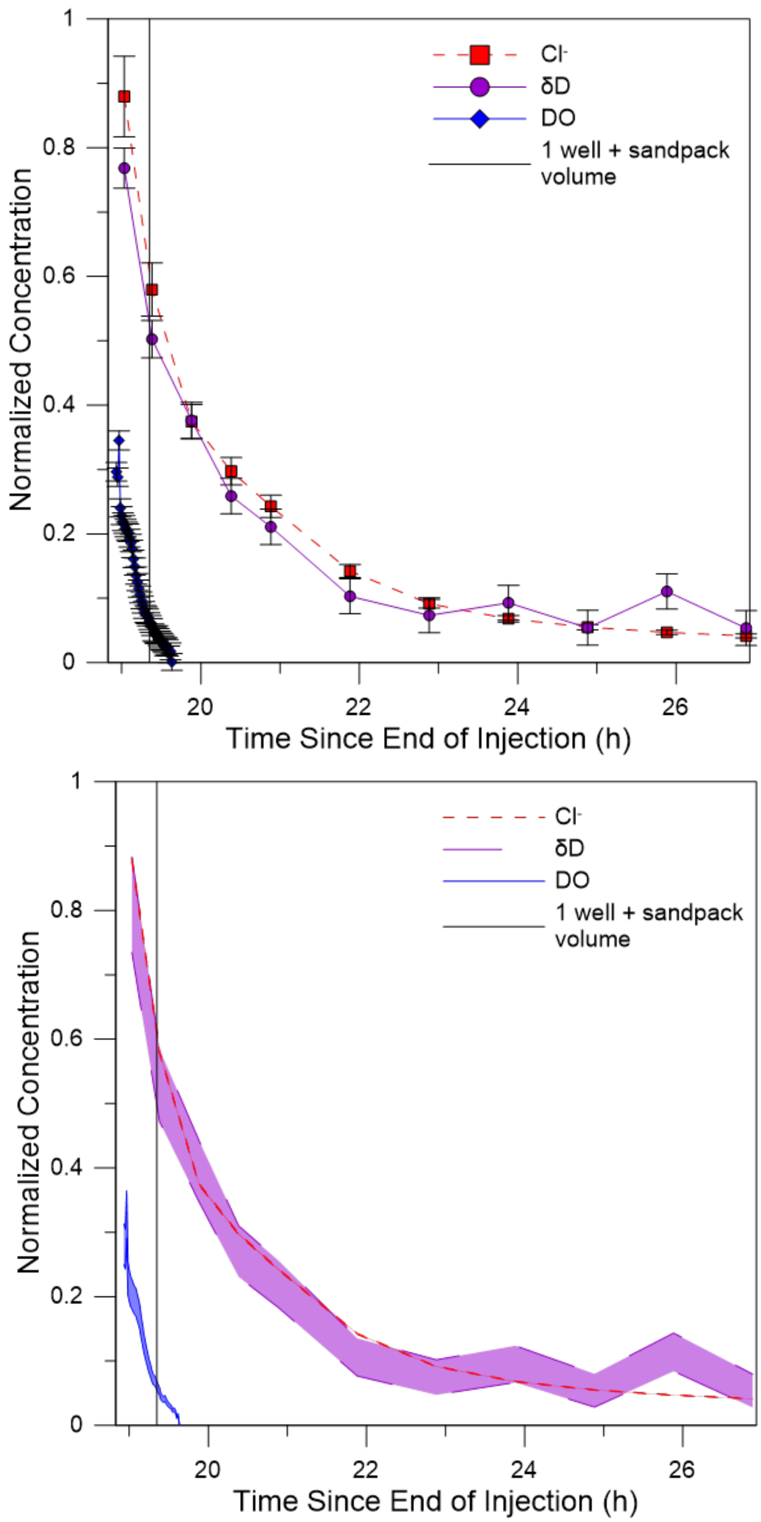

Figure 5.3. Normalized concentrations of tracers for Test 1 at Well 1D with error bars from propagation of errors of precisions (a) and the range in calculated normalized concentration (b). The range for normalized Cl is small, and appears as a single dashed line (b).

Concentrations of conservative tracers remained elevated compared to background concentrations for the duration of the extraction phase, with final concentrations of 29.8 mg/L and -140.3‰ for Cl^- and δD respectively. The resulting normalized concentrations were 0.04 and 0.05 for Cl^- and δD, respectively. At the end of the extraction phase, temperature, pH, ORP, and alkalinity were 5.5°C, 7.0, 398 mV, and 383 mg/L as $CaCO_3$, respectively. The normalized concentration of DO was initially lower than that of the conservative tracers, and quickly decreased to below detection (at 19.7 h since end of injection), indicating that DO concentrations returned to background levels.

Because there is greater variability in δD than Cl^- (Figure 5.3 (b)), either Cl^- or specific conductivity was used as the conservative tracer for data analysis. Specific conductivity was measured each minute during all phases of push-pull tests, and so C/C_0 values can be calculated at the same frequency as for DO (whereas Cl^- was measured at a lower frequency).

Ratios of recovered conservative tracer mass to injected tracer mass (percent recovery) for conservative tracers during Test 1 were similar: 53% for Cl^- and 51% for δD. In contrast, only 3.1% of the injected DO was recovered. It is assumed that the decline in the concentrations of the conservative tracers was due to dilution and mixing with formation water and additional losses of DO mass is attributed to redox processes where DO is used as an electron acceptor. Oxygen yields more free energy than NO_3^- or Se reduction, and is therefore thermodynamically more favourable as an electron acceptor (Bao *et al*., 2013; Rivett *et al.*, 2008).

The value of k for DO was estimated for Test 1 at Well 1D based on the Haggerty *et al.* (1998) and Schroth and Istok (2006) methods. A maximum reaction rate for DO was also calculated for Test 1 using first-order reaction kinetics (Equation 4.10) and the dilution factor (i.e., the normalized concentration at each time) of specific conductivity.

The extraction phase for Test 1 commenced 18.8 h after the completion of the injection phase. One well and sandpack volume had been purged from the well at 19.4 h since the end of the injection. DO concentrations returned to background levels in 19.6 h. Using data collected between 19.4 and 19.6 h the estimate of k using the Haggerty method was 4 h^{-1} (Figure 5.4). Neither Cl^- nor δD could be used as conservative tracers for the Haggerty method, because only one sample was analysed for the time period of 19.4 to 19.6 h.

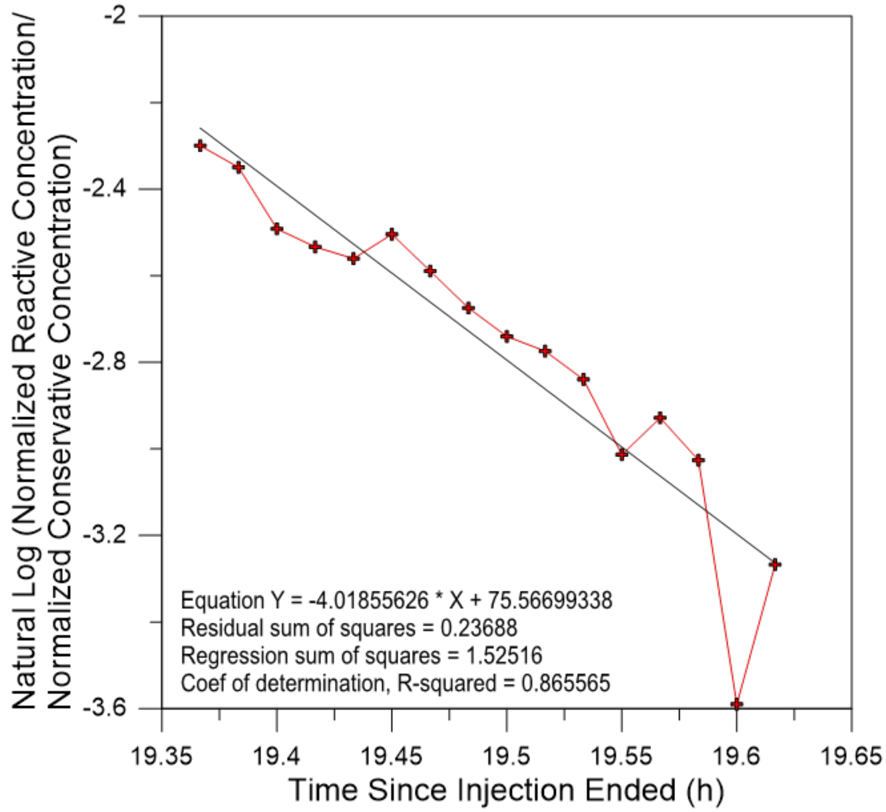

Figure 5.4. Plot of Test 1 data for analysis of k using the method from Haggerty *et al.* (1998). Data points are from Hydrolab measurements (red crosses), and the black line is a linear regression line. Statistics for the plot are provided in the figure.

The y-intercept (b) from Figure 5.4 is 75.6. A value for k can be determined from the slope of the line, and can also be evaluated based on the intercept, b, using Equation 2.5. The goal seek function in Microsoft Excel was used to approximate k using the b value determined from the plot (Figure 5.4). A value of 50.5 h^{-1} for k was calculated, which is roughly 12.5 times larger than the k value from the slope of the plot. The large difference in the values indicates that this method does not yield reliable estimates of k for data of this study.

Haggerty *et al.* (1998) examined a number of factors which could affect the shape of the plot (Figure 5.4), and found that in considering porosity, dispersivity, injection time, and k, only k strongly affected the shape of the plot. The elapsed time since injection used by Haggerty *et al.* (1998) in their comparisons was only up to 6 h. The first reading used for analysis for Test 1 occurred at 19.4 h since injection ended. The increased length of the x-axis, limited number of data points, and no data points at early times (times < 19.4 h), could lead to errors in the estimation of the slope and b, and therefore error in the estimate of k. The standard error for Test 1 data was

0.42, while the highest standard error reported by Haggerty *et al.* (1998) was 0.011. The paper (Haggerty *et al.* (1998)) notes that if the aquifer is spatially heterogeneous, as is likely the case in the highly heterogeneous waste rock pile, k is often over estimated, and can lead to estimation errors of up to 200% (Haggerty *et al.*, 1998).

The Haggerty method assumes the spiked water instantaneously becomes well mixed within the portion of the aquifer surrounding the test well. Schroth and Istok (2006) present a plug-flow model for analysis of push-pull tests, as well as a variably mixed model. The variably mixed model could not be employed because it requires information on the duration of each particle's residence time in the formation. The plug-flow model was employed for Test 1 data (Figure 5.5).

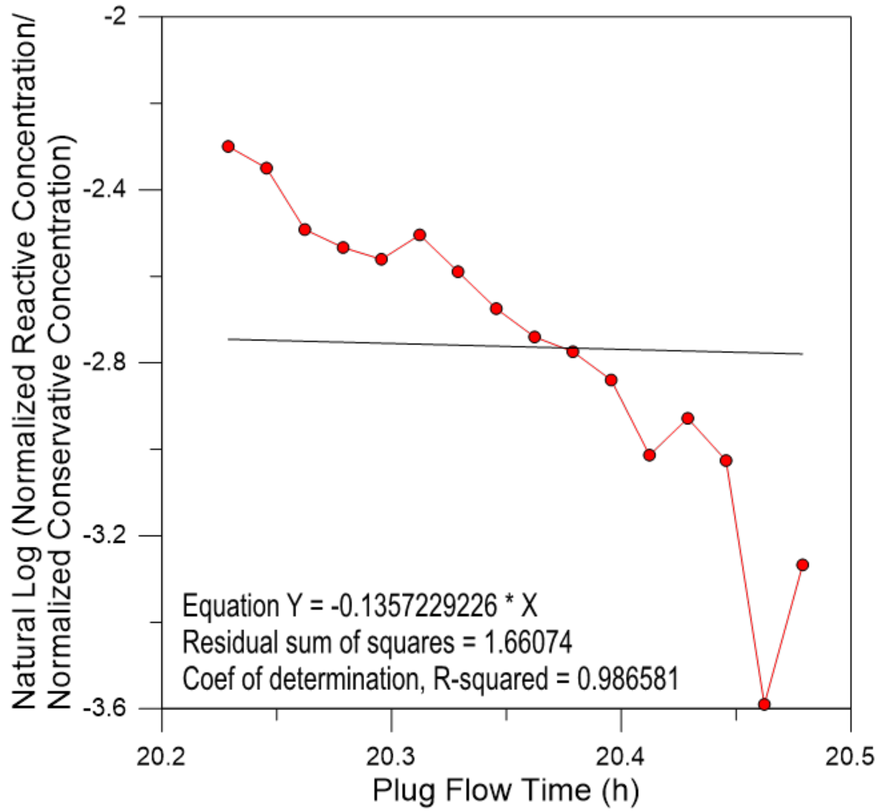

Figure 5.5. Plot of Test 1 data using the Plug Flow model from Schroth and Istok (2006). Data points are from Hydrolab measurements (red circles), and the black line is a linear regression line. The y-intercept is forced through 0 in this model. Statistics for the plot are presented on the plot.

The slope from Figure 5.5 yields a k estimate of 0.14 h^{-}. The match of the trend line to the measured data is greatly affected by forcing the trend line through y = 0 (Equation 2.6), as indicated by the low R^2 value. Similar to Haggerty *et al.* (1998), examples provided by Schroth and Istok (2006) have short x-axis times (maximum plug flow time is 2.5 h) compared to the plug flow times calculated for Test 1, and the absence of data points between 0 and 20.2 h has likely resulted in a skewed trend line, and an inaccurate estimate of k.

Matching observed DO concentrations to normalized conservative species concentrations decreased by a ratio representing a first-order decay reaction (Equation 4.10) produced a k value of 0.32 h^{-} (half-life of 2 h). This value agrees closely with the value of 0.368 h^{-} determined by Vandenbohede and Lebbe (2006) for aerobic respiration. Their study also used push-pull tests saturated with DO, and was conducted in Quaternary sediments on the Belgian coastal plane with an Eh of -51 mV (Vandenbohede and Lebbe, 2006). These authors used the Haggerty *et al.* (1998) method to calculate k, however the extraction phase started immediately after the end of injection in their experiment, providing the authors with early time data. The k value for Well 1D is greater than those calculated for Well 3 (0.03 h^{-1} for 2013 and 0.07 h^{-1} for 2014). The thicker saturated zone at Well 1D likely means that there are stronger reducing conditions present, resulting in higher k values, and quicker consumption of oxygen in the formation surrounding Wel1 1D. The fact that DO was consumed at both Well 3 and 1D indicates that reducing conditions were present in the saturated backfill.

5.3.2.2 Test 2

The DO concentrations in the water during purging and filling of the holding tank for Test 2 at Well 1D were below detection (<0.01 mg/L). The average DO concentration during injection was 1.28 mg/L (standard deviation: 0.46, n = 107). Results for tracer concentrations from background and spike samples are provided in Table 5.4. Background water temperature, pH, ORP, and alkalinity were 4.8°C, 6.9, 376 mV, and 380 mg/L as $CaCO_3$ respectively. Spiked water temperature, pH, ORP, and alkalinity were 9.1°C, 7.6, 421 mV, and 386 mg/L as $CaCO_3$, respectively.

Table 5.4. Results of background and spike sampling from Test 2 at Well 1D.

Species, Stage	Average Concentration/Value	Standard Deviation	Number of Samples
Cl^-, Background	19.6 mg/L	3.0 mg/L	4
δD, Background	-143.2‰	1.6‰	4
Se, Background	0.099 mg/L	0.012 mg/L	4
Cl^-, Spike	709.48 mg/L	0.99 mg/L	4
δD, Spike	-44.7 ‰	1.9‰	4
Se, Spike	0.9209 mg/L	0.0086 mg/L	4

The first sample for analysis during the extraction phase was collected after 30 L of extracted water had passed through the flow meter. Tracer concentrations from this sample were: 396 mg/L Cl^-, -90.0‰ δD, and 0.479 mg/L Se. These concentrations resulted in normalized concentrations of 0.55, 0.54, and 0.45 for Cl^-, δD, and Se, respectively. As with Test 1, this first sample was not used for data analysis. The second sample, collected at 209 L extracted had concentrations of 248 mg/L Cl^-, -110.8‰ δD, and 0.330 mg/L Se. The resulting normalized concentrations were 0.33, 0.33, and 0.28 for Cl^-, δD, and Se respectively. At the time of sampling, water temperature, pH, ORP, and alkalinity were 5.5°C, 6.9, 434 mV, and 383 mg/L as $CaCO_3$, respectively. Normalized concentrations for each of the tracers throughout the extraction period are shown in Figure 5.6. Note that the longer reaction time in Test 2 compared to Test 1 (67 vs. 19 h) resulted in lower initial normalized concentrations due to greater dilution.

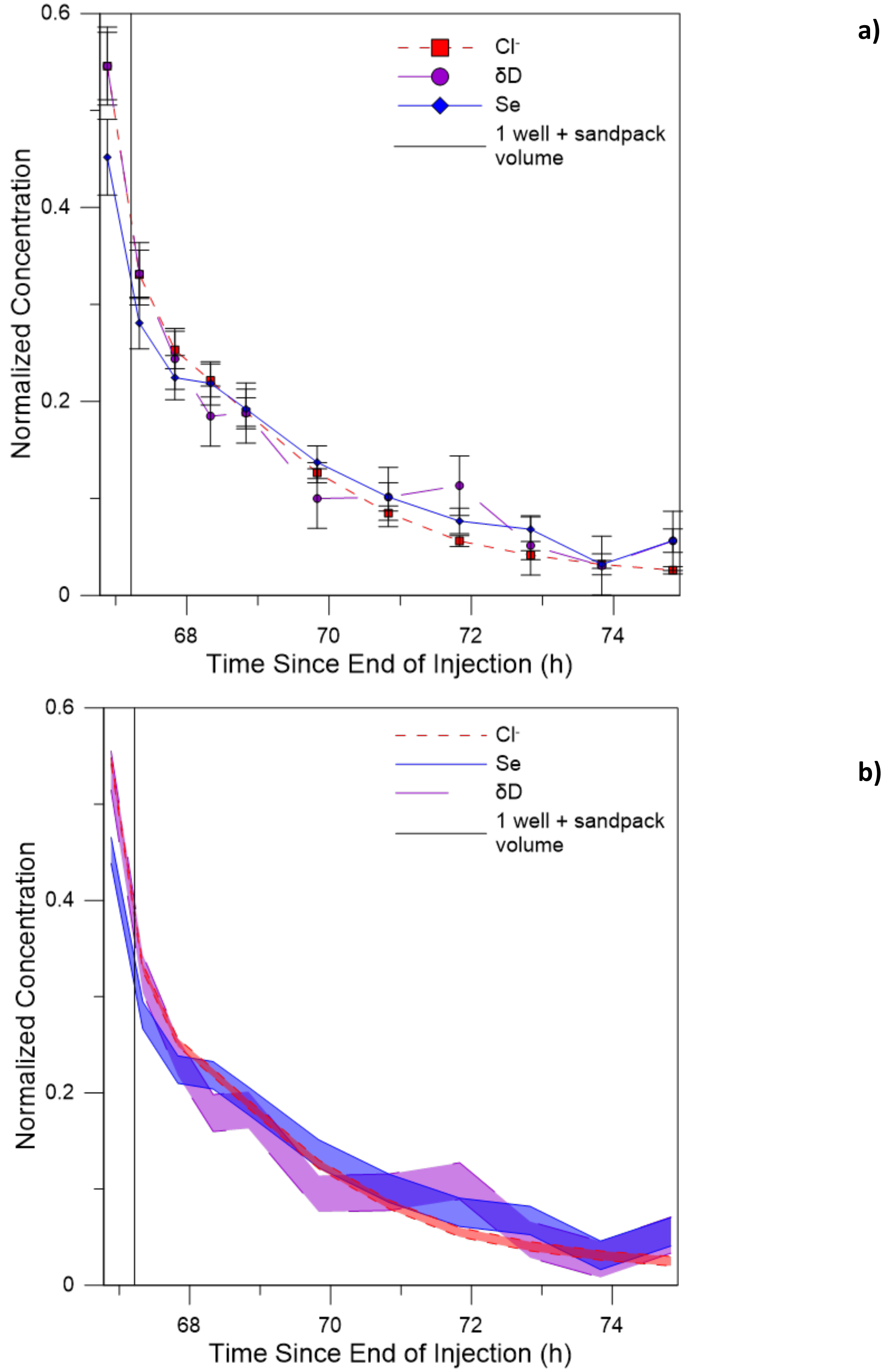

Figure 5.6. Normalized concentrations of tracers for Test 2 at Well 1D with error bars from propagation of errors of precisions (a) and the range in calculated normalized concentration (b).

Final concentrations (taken at 74.8 h since end of injection) were: 37.6 mg/L Cl^-, -137.7‰ δD, and 0.146 mg/L Se. Resulting normalized concentrations for Cl^-, δD, and Se were: 0.03, 0.06, and 0.06, respectively. Water temperature, pH, ORP, and alkalinity were 6.0°C, 6.9, 411 mV, and 382 mg/L as $CaCO_3$, respectively. Initially, normalized Se concentrations were lower than normalized concentrations of Cl^- or δD. From the third sample (at 67.8 h) onward, the normalized Se concentration fell within, or slightly above, the range of the normalized conservative tracers (Figure 5.6).

Although the normalized concentration of Se was initially lower than that of the conservative tracers, it did not maintain this trend. If reduction were occurring, a normalized concentration trend similar to that of DO from Test 1 would be expected, where normalized Se concentrations would be lower than the conservative tracers throughout extraction. The initially low concentrations of Se compared to the conservative tracers could be due to sorption processes. If sorption were occurring, there would be additional loses of Se. Towards the end of extraction, where conservative concentrations have almost returned to background levels, the presence of slightly elevated Se concentrations could be due to desorption of sorbed Se. The percent recovered above background was 43% for all tracers (Cl^-, δD, and Se) for this test. This observation suggests that Se was not immobilized in the formation on the time and scale of the push-pull test (i.e., no loss of Se mass above that due to dilution over the testing period).

During sampling of background concentration it was observed that the concentration of Cl^- in Test 2 declined with time, while the average concentration of Se and δD remained relatively constant. The decline in Cl^- concentration was attributed to the presence of residual Cl^- from Test 1. As a consequence, the average of the four background samples was used as the background concentration of Se and δD; while only the final background sample for Cl^- was used to represent background concentrations for the calculation of percent recovered. Because the standard deviation of Cl^- was high (15% of the average value), while the standard deviation for δD was low (1% of the average value), this method was used for Cl^- only. Although the average background concentration is used in the calculation of normalized concentration (Figure 5.6 (a)), the variability in the background concentrations is taken into consideration by showing a range in possible normalized concentrations for Cl^- (Figure 5.6 (b)). Selenium was not introduced as a tracer in Test 1, and so its concentration should not be affected by residual effects from the previous test.

Although the concentration of Se should not have been affected by Test 1, the standard deviation (as a percent of the average) for the four background samples was 12%. This highlights the difficulty in obtaining an accurate value for the background concentration of Se at this site. Having an accurate value for background concentration is important for both percent recovery calculations as well as the calculation of normalized concentrations. Natural variations in concentrations of the tracers increase error in both calculations, especially when they represent a substantial percentage of the sample concentration during extraction. Of the three tests conducted at Well 1D, the standard deviation for Se was actually the lowest (as a percent of the average value) for background samples from Test 3, where it is possible that residual Se injected from Test 2 was being extracted.

A Pourbaix diagram was constructed using Test 2 data, and indicates that, based on thermodynamics, the expected form of Se in the extracted water is Se^{4+} (Figure 5.8). Selenite has a high affinity for sorption sites and has the potential to form strong complexes, which could limit its mobility in the saturated fill (Fernández-Martínez and Charlet, 2009; Guo *et al*., 1999; Han *et al*., 2012). If Se was being sorbed in the saturated backfill, it may have also undergone desorption during the extraction phase because the percent recovery of Se was the same as that of the conservative tracers indicating that no Se attenuation occurred during the push-pull test.

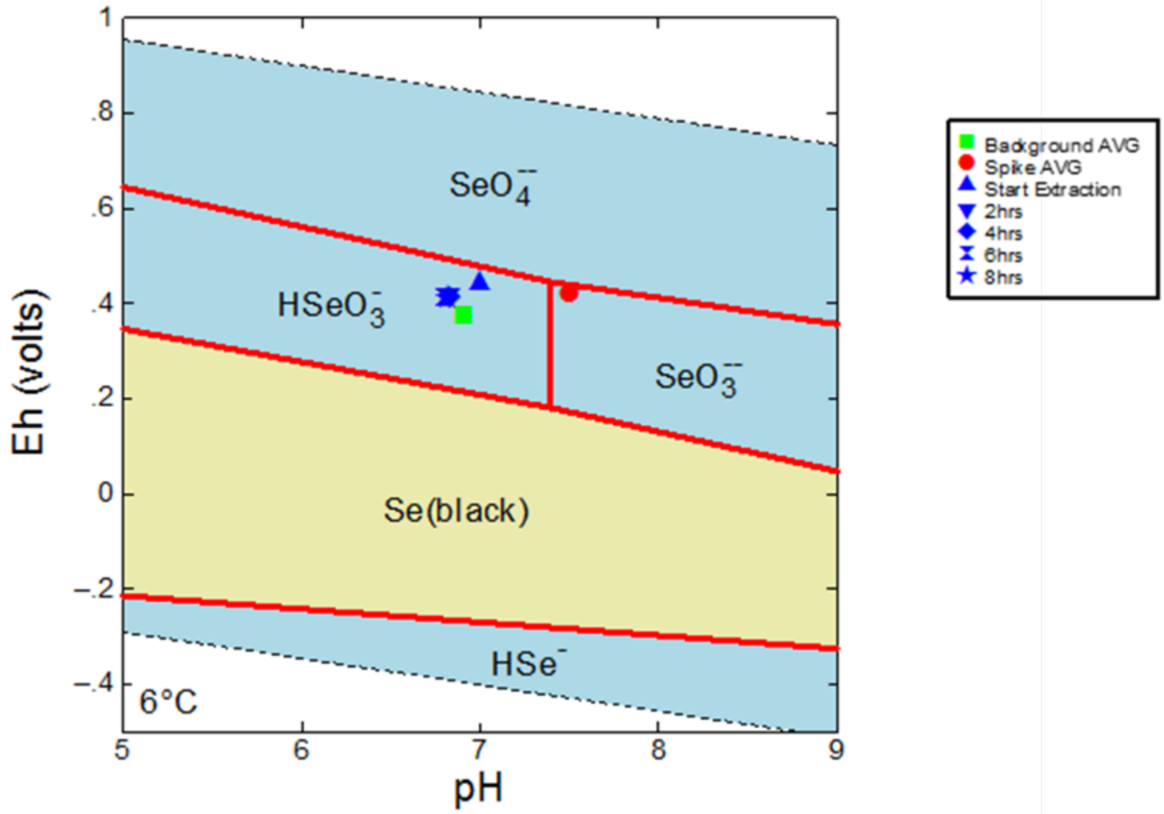

Figure 5.7. Pourbaix diagram for push-pull Test 2. Values of Eh and pH are from Hydrolab measurements. Diagram temperature, pressure, and activity of SeO_4^{2-} are 6°C, 1.013 bars, and $10^{-5.7}$, respectively.

5.3.2.3 Test 3

Test 3 was the final push-pull test conducted at Well 1D. Background water temperature, pH, ORP, and alkalinity were 4.9°C, 6.8, 395 mV, and 382 mg/L as $CaCO_3$, respectively. Background DO was below detection, and average spike DO was 1.70 mg/L (standard deviation: 0.22 mg/L, n = 115). Spiked water temperature, pH, ORP, and alkalinity were 6.3°C, 7.6, 438 mV, and 380 mg/L as $CaCO_3$, respectively. Background and spike tracer concentrations are provided in Table 5.5.

Table 5.5. Results of background and spike sampling from Test 3 at Well 1D.

Species, Stage	Average Concentration/Value	Standard Deviation	Number of Samples
Cl^-, Background	28.7 mg/L	3.9 mg/L	4
δD, Background	-142.2‰	2.7‰	4
Se, Background	0.1158 mg/L	0.0073 mg/L	4
NO_3^-, Background	150.24 mg/L	0.64	4
Cl^-, Spike	737.5 mg/L	1.4 mg/L	4
δD, Spike	-56.1 ‰	6.4‰	4
Se, Spike	0.911 mg/L	0.031 mg/L	4
NO_3^-, Spike	357.8 mg/L	1.0 mg/L	4

The first sample for analysis during the extraction phase occurred after 40 L of extracted water had passed through the flow meter. Concentrations of tracers for this first sample were 297 mg/L Cl^-, -110.7‰ δD, 0.382 mg/L Se, and 227 mg/L NO_3^- as N. These concentrations result in normalized concentrations of 0.38, 0.37, 0.34, and 0.37 for Cl^-, δD, Se, and NO_3^- respectively. As in the previous two tests, this first sample was not used for data analysis. The second sample, collected at 226 L extracted had concentrations of 210 mg/L Cl^-, -113.3‰ δD, 0.255 mg/L Se, and 213 mg/L NO_3^- as N. Normalized concentrations from this sample were 0.26, 0.34, 0.18, and 0.30 for Cl^-, δD, Se, and NO_3^- respectively. Water temperature, pH, ORP, and alkalinity were 4.9°C, 7.0,, 379 mV, and 396 mg/L as $CaCO_3$. Normalized concentrations throughout the extraction phase are plotted below in Figure 5.8.

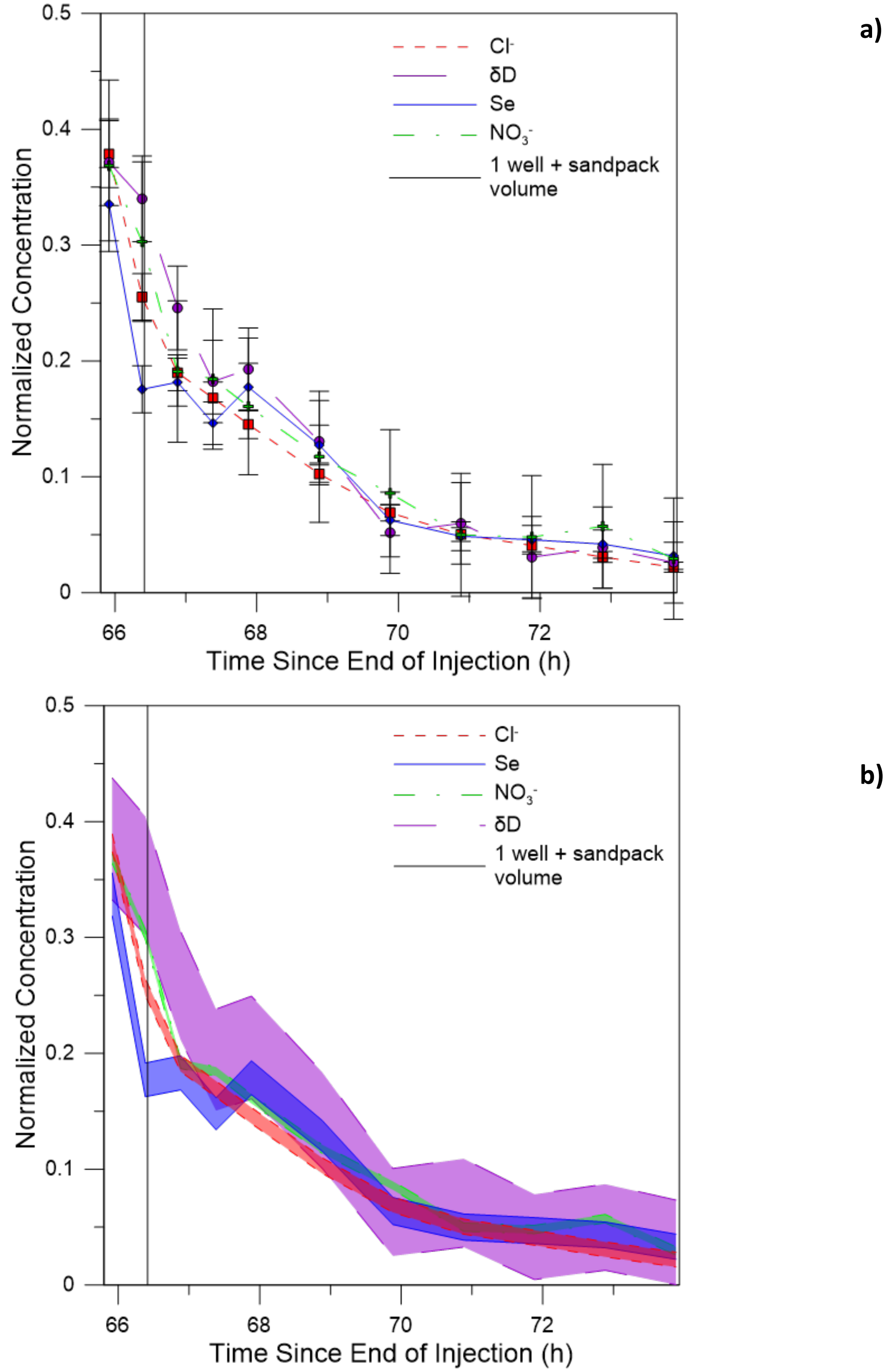

Figure 5.8. Normalized concentrations of tracers for Test 3 at Well 1D with error bars from propagation of errors of precisions (a) and the range in calculated normalized concentration (b).

At the end of extraction, water temperature, pH, ORP, and alkalinity were 5.2°C, 7.0, 374 mV, and 397 mg/L as $CaCO_3$, respectively. Tracer concentrations at the end of extraction were 44.3 mg/L Cl^-, -140.0‰ δD, 0.141 mg/L Se, and 156 mg/L NO_3^- as N, respectively. The resulting final normalized concentrations for this test were 0.02, 0.03, 0.03, and 0.03 for Cl^-, δD, Se, and NO_3^-, respectively.

Initial Se samples had lower normalized concentrations than the conservative tracers, which is consistent with Test 2. The normalized Se concentration became greater than the normalized concentration of Cl^- at approximately 68 h since the end of injection, and remained elevated until the end of extraction expect for the samples collected at 70 and 71 h. This trend is similar to the trend of Se in Test 2, and may be the result of sorptive and/or back diffusion processes.

Normalized NO_3^- concentrations are similar to normalized Cl^- concentrations and suggest that no NO_3^- attenuation was occurring during the push-pull test. The fact that normalized NO_3^- was generally slightly higher than normalized Cl^- may be due to effects of residual Cl^- left in the formation from Tests 1 and 2. Residual Cl^- may have led to slight errors in the values of background Cl^- used to calculate normalized concentrations (note the increasing error range for Cl^- from Test 1 (Figure 5.3 (b)) to Test 2 (Figure 5.6 (b)) to Test 3 (Figure 5.8 (b)).

The mass recovered (above background) for Test 3 was 38% for Cl^-, 36% for Se, 40% for NO_3^-, and 41% for δD. These values indicate that neither Se nor NO_3^- were attenuated in the formation during the push-pull test. As for Test 2, the final background sample, as opposed to the average of the four samples, was used for percent recovery calculation of Cl^-, due to the high variance in Cl^- concentration in the background samples. Tests 2 and 3 yielded similar percent recoveries, which was expected because they had similar reaction times (66.9 h and 65.9 h for Tests 2 and 3, respectively), and volumes injected (1005 L and 910 L for Tests 2 and 3, respectively).

Pourbaix diagrams for both Se and N for Test 3 (Figure 5.9) suggest that reduced species of Se and N are expected during the extraction phase. Contrary to the Pourbaix diagram, the normalized concentrations and percent recovery for NO_3^- do not indicate that any NO_3^- has been attenuated or reduced throughout the duration of this push-pull test. As with Test 2 (Figure 5.7), the thermodynamics indicate that Se should be present as Se^{4+}, and therefore sorption of the Se^{4+}

to mineral surfaces could lead to attenuation of Se. The percent recovery for Se does not indicate that any Se has been attenuated in the saturated backfill over the duration of this push-pull test.

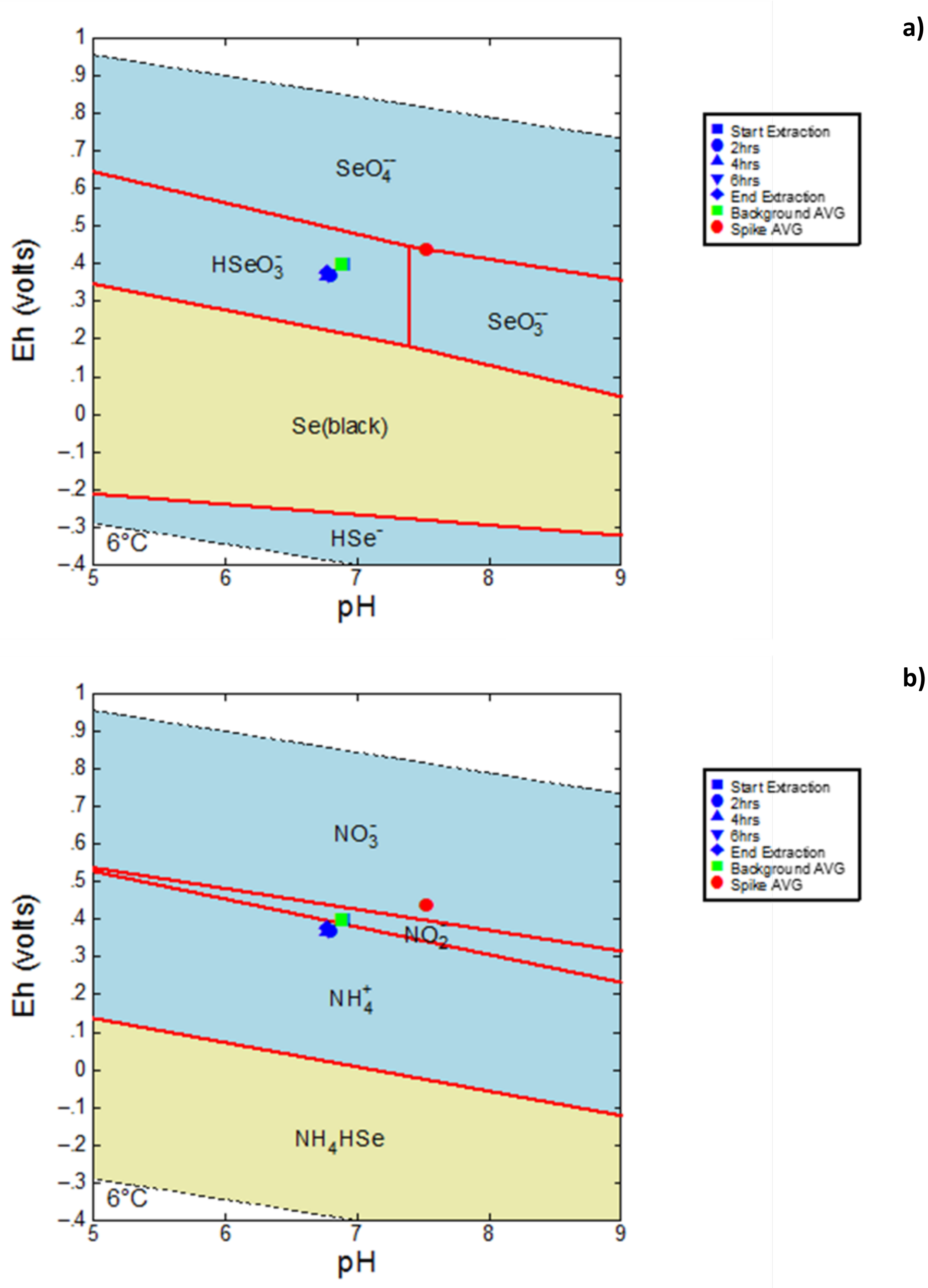

Figure 5.9. Pourbaix diagram for redox conditions of Test 3 with Se^{6+} (SeO_4^{2-}) as the species of interest (a) and NO_3^{2-} as the species of interest (b). Values of Eh and pH are from Hydrolab measurements. Diagram temperature and pressure are 6 °C and 1.013 bars, respectively (both (a) and (b)). The activity of SeO_4^{2} is $10^{-5.7}$ (a). The activity of NO_3^- is $10^{-2.5}$ and $N_{2(aq)}$ and $N_{2(g)}$ are suppressed (b).

5.3.2.4. Selenium Speciation

Speciation data for Test 2 indicate that the only changes in the form of Se are the result of mixing between spike and formation water (Figure 5.10). The mixing curve in Figure 5.10 was generated from mixing between two waters using the average values of Se^{4+} and Se^{6+} from the spike and background samples as end members. A shift to the left of the mixing curve (lower total Se), and also up (towards higher Se^{4+}/Se^{6+} ratios) would be expected if Se^{6+} is being reduced to Se^{4+}. No such shift was observed in the results from Test 2.

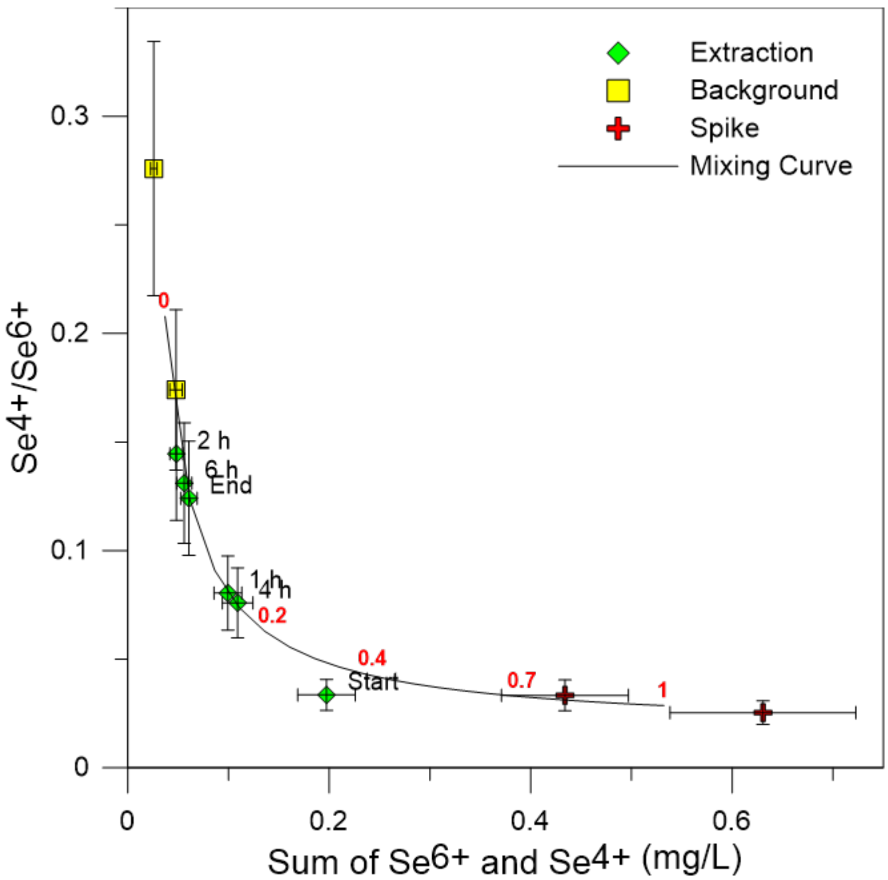

Figure 5.10. Selenium speciation data for water samples from Test 2. A mixing curve (black line) and proportions of mixing of spike water with formation water (red numbers) are also presented.

The first sample of the extraction phase ('start' in Figure 5.10) was collected before one well and sandpack volume was purged, and likely represents water from either the well casing or the sandpack, and not water extracted from within the formation.

Although data in Figure 5.10 exhibits a mixing trend, the order of the extracted samples is not consistent with the expected sequence; mixing should yield samples that move from the bottom right (spike-like water) to the top left (background water) of the plot as extraction progresses. Samples from the early stages of extraction undergo less dilution, and so should be more similar to the spike water than samples collected at the end of extraction. The sample collected 2 hours after the start of extraction best reflects the background samples, while the sample taken 4 hours into extraction is the second closest (after the sample taken at the start of extraction) to the spike samples. The cause of the distribution of these data is not certain; it may be due to changes in redox conditions during sampling - some samples may have been exposed to more oxidation during sample filtration, transfer, and storage than others resulting in a change in oxidation state - or water was being extracted from different flow paths, resulting in differing degrees of dilution.

Test 2 Se speciation data had Se^{4+} concentrations above detection for all samples, whereas for Test 3, only one sample (the sample collected at 4 h into extraction) had Se^{4+} concentrations above background and, as a result, no mixing curve could be generated for Test 3. The decline in the concentration of Se^{4+} in Test 3 samples may have occurred due to the presence of residual Se^{6+} from Test 2 present in the formation during Test 3. Selenium concentrations fluctuate frequently in the Henretta saturated backfill (Figure 6.3), and it is possible that speciation changes occur along with the concentration fluctuations. These fluctuations could also have been responsible for the decrease in Se^{4+} in Test 3 compared to Test 2, although this is unlikely given that there was only 4 days between the end of Test 2 and start of Test 3.

Selenate versus total Se (as measured from the ICP-OES) is presented in Figure 5.11. Samples results for both Test 2 and 3 yielded high total Se and Se^{6+} concentrations (spike-like conditions) initially. Results then decreased to lower total Se and Se^{6+} concentrations (background conditions) as the extraction phase proceeded. There is an unexpected difference in the Se^{6+} concentration of the Test 2 spike samples (0.615 vs. 0.420 mg/L), despite the fact that the spiked water should be homogenous and yield similar results. Although there is a relatively large difference in the Se^{6+} concentrations, total Se is almost identical (0.929 and 0.926 mg/L). There is also a relatively large difference in the mass of Se unaccounted for (i.e., the difference between ICP-OES measured Se concentration and summed concentrations of Se^{4+} and Se^{6+} measured from the HPLC-ICP-MS divided by the ICP-OES measured Se concentration) between the two spike samples from Test 2 (32 vs. 53%) (Figure 5.13). The 'mass unaccounted for' does not refer to Se that is lost, but rather it is the difference in Se concentration measured on the ICP-OES and the HPLC-ICP-MS. The ICP-OES measures all Se, whereas the HPLC-ICP-MS only measures Se^{6+} and Se^{4+}, and so the mass 'unaccounted for' is Se in forms other than Se^{6+} or Se^{4+}. The sample with the lower Se^{6+} concentration (Spike 2) has a higher percent of unaccounted for Se mass. The unaccounted for Se could be organically bound Se or other Se complexes, which would be included in the measurement of total Se from the ICP-OES, but would not be measured as either Se^{4+} or Se^{6+} by the HLPC-ICP-MS. It is possible that more Se^{6+} in spike sample 2 of Test 2 formed complexes than the other spike samples, leading to a lower concentration of Se^{6+} and higher percent of unaccounted for Se mass.

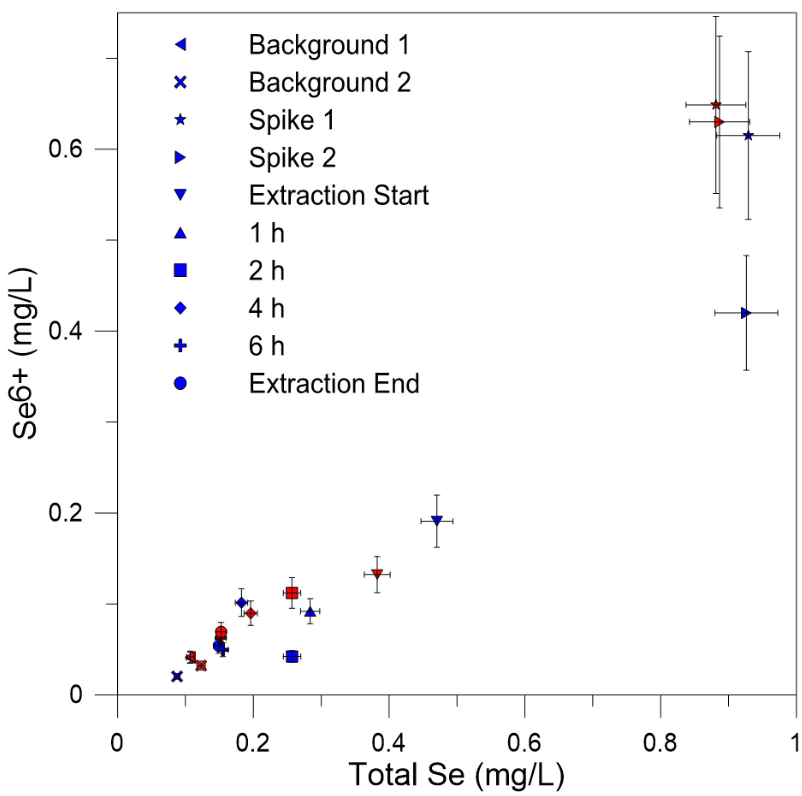

Figure 5.11. Measured Se^{6+} (HPLC-ICP-MS) versus measured total Se (ICP-OES) for Test 2 data (dashed blue line) and Test 3 data (solid red line).

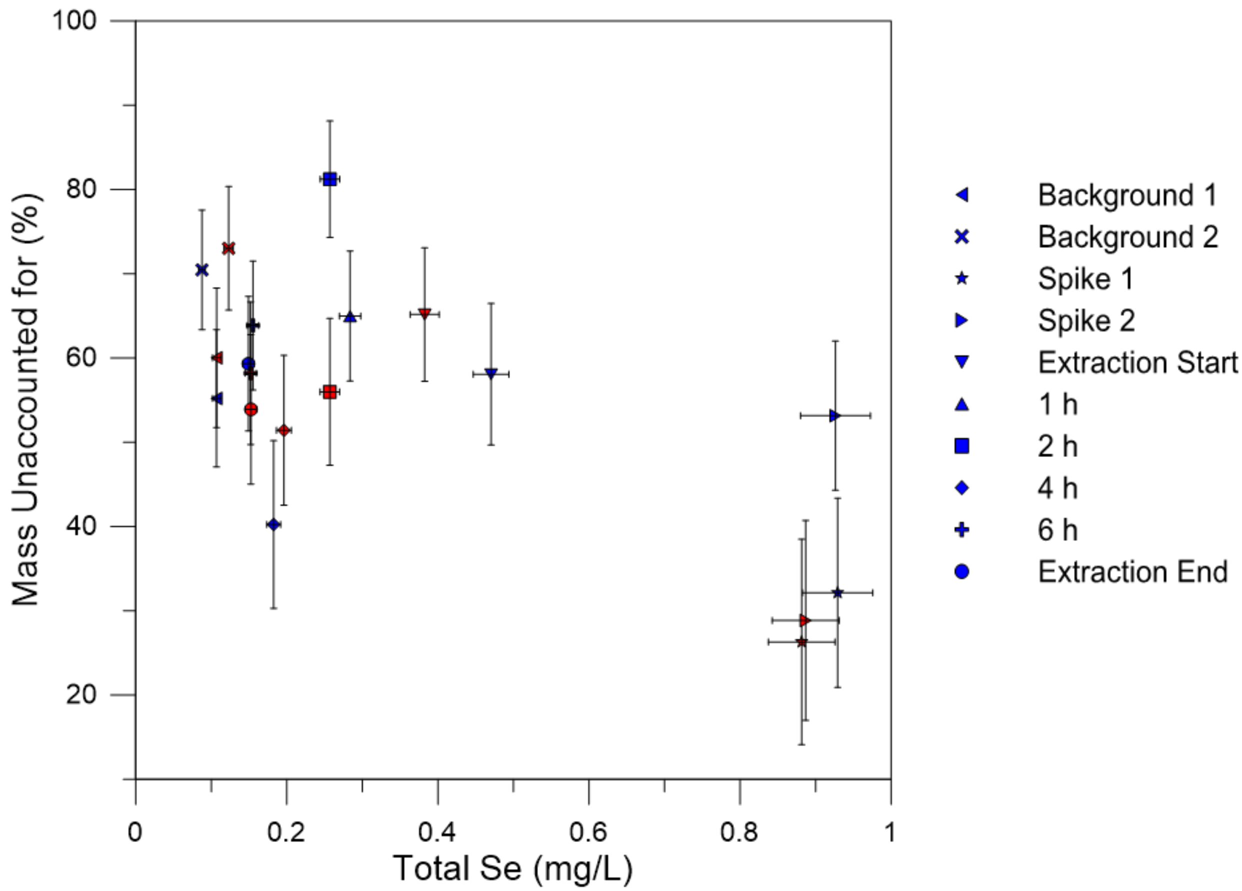

Figure 5.12. Mass unaccounted for versus measured total Se (ICP-OES) for Test 2 data (dashed blue line) and Test 3 data (solid red line).

There were large differences between the total Se concentration measured from the ICP-OES and the total concentration as a sum of Se^{4+} and Se^{6+} (Figure 5.12) for many samples from Tests 2 and 3. The mass unaccounted for ranged from 32 to 81% for Test 2, and from 26 to 73% for Test 3. In both tests, the lowest mass of unaccounted for Se was from one of two spike samples, where Se concentration was dominated by Se^{6+} from the sodium selenate spike. In the case of Test 3, the largest mass unaccounted for was from one of two background samples, whereas it was the sample collected 2 h into extraction (which was the sample closest to background conditions (Figure 5.12)) for Test 2. The highest mass unaccounted for was expected to occur in the background samples because Se would have more time to form complexes. It appears that for Test 2 the sample collected at 2 h into extraction is comprised primarily of background waters, with little contribution of spike water based on the Se^{4+}/Se^{6+} ratio and amount of Se present as neither Se^{4+} nor Se^{6+}. This again highlights the potential of different contributing flow paths during extraction, and complexity of the saturated backfill in terms of both geochemistry and hydrogeology.

5.4 Nitrate Isotopes

Concentrations of NO_3^- at the time of NO_3^- isotope sampling were 139, 153, and 13 mg/L as N for samples collected in September of 2013 for Wells 1S, 1D, and 3, respectively, and 197, 173, and 26 mg/L as N for samples collected in May of 2014 for Wells 1S, 1D, and 3, respectively. The results of NO_3^- isotope analyses are presented in Figure 5.13 (a).

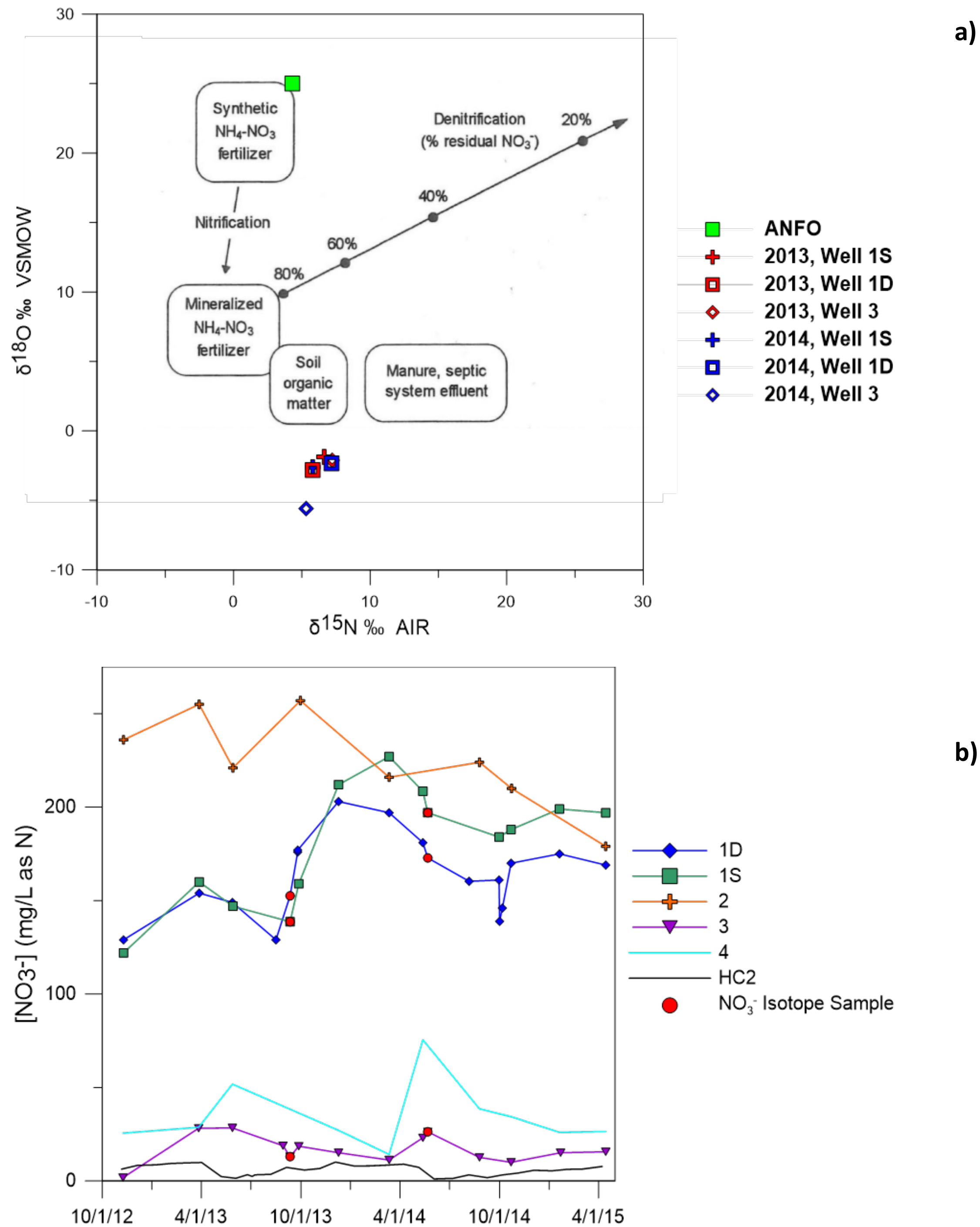

Figure 5.13. Nitrate isotope results for samples from Henretta study area in 2013 and 2014 (green, red, and blue symbols) and theoretical nitrification and denitrification for groundwaters with $\delta^{18}O$ ~ -10‰ (black)(Clark and Fritz, 1997) (a). Samples used for NO_3^- isotope analysis are shown as red circles on the plot of NO_3^- concentration versus time for Wells 1D, 1S, and 3 (b). NO_3^- concentrations for Wells 2 and 4, and creek monitoring location HC2 are also shown (symbols represent sampling events). The ANFO sample (solid green square) in (a) is pre-detonated ANFO dissolved in DI water (Mahmood *et al.*, 2016).

The large change in $\delta^{18}O$ values from the ANFO to the groundwater samples can be attributed to nitrification of the NH_4^+ in the ANFO. In synthetic forms of NO_3^- such as ANFO, the O molecules are primarily derived from atmospheric O_2. During nitrification, two O_2 molecules are derived from water, which will have more depleted $\delta^{18}O$ values than atmospheric O_2 ($\delta^{18}O$ typically ~ -19‰ for groundwater samples from Henretta), resulting in a shift toward more depleted $\delta^{18}O$ values as nitrification occurs (Clark and Fritz, 1997). Since the process of denitrification favours the consumption of the light isotope of both O and N in reactions, there should be a shift towards more enriched values of $\delta^{18}O$ and $\delta^{15}N$ in the residual groundwater as denitrification occurs (Figure 5.13 (a)). This trend is not observed in the samples from Henretta (Figure 5.13 (a)), suggesting no denitrification occurred in these three locations at the times of sampling.

Nitrate concentrations were beginning to increase at Wells 1D and 1S at the time of the first NO_3^- isotope sample collection. It is thought that prior to this increase, denitrification may have occurred in these wells, and caused the lower concentrations of NO_3^- at 1D and 1S compared to Well 2 (Figure 5.13 (b)). Well 2 is assumed to represent oxic waste rock effluent. The second sample at 1D and 1S was taken as NO_3^- concentrations were beginning to decline again, indicating that denitrification may have been occurring. If denitrification were occurring, it was not occurring at a measureable rate, as evidenced by the lack of shift in NO_3^- isotopes along the denitrification line (Figure 5.13 (a)).

Nitrate isotope samples at Well 3 were collected at a time of low NO_3^- concentration (September 2013), and at a peak in NO_3^- concentration (May 2014). Neither of these samples suggest measureable denitrification was occurring. Based on both the lower NO_3^- concentrations compared to Wells 1D, 1S, and 2, as well as the high SO_4^{2-}/NO_3^- ratio at Well 3 (SO_4^{2-}/NO_3^- mean values of 22, 17, 9.8, 8.3, and 6.1 for HC2 and Wells 3, 1D, 1S, and 2, respectively), it is likely that dilution by way of mixing with creek water is occurring at Well 3. This possibility is explored further in Section 6.2.

The finding of no quantifiable denitrification based on NO_3^- isotope analysis is in agreement with push-pull test results (Test 3) (Figure 5.8), and the high NO_3^- concentrations present at Wells 1D and 1S (Figure 5.13 (b)). The lack of quantifiable NO_3^- reduction is not, however, consistent with the Pourbaix diagram constructed from measurements collected during push-pull Test 3 (Figure 5.9 (b)).

5.5 Dissolved Organic Carbon

Results from DOC analysis are provided in Table 5.6. Dissolved organic carbon concentrations ranged from 0.6 to 1.0 mg/L, with a mean value of 0.8 mg/L, which is typical for groundwater. For example, measured DOC concentrations are consistent with concentrations reported in Rivett *et al.* (0.7 - 1.8 mg/L) (2007) and Trudell *et al.* (1 - 3 mg/L) (1986), but are lower than those expected for water associated with coal (5 - 10 mg/L) (Thurman, 1985).

The bioavailability of the DOC from the study area is not known, but it is likely that the DOC is mature carbon material and therefore less labile than immature carbon material (Postma and Boesen, 1991). The mature nature and low concentrations of DOC present suggest that inorganic electron donors (e.g., reduced forms of Fe and S) may be important electron donors at this site. In a study by Schwientek *et al.* (2008), the authors assume a pyrite electron donor for denitrification based on DOC concentration measurements that were generally < 1 mg/L.

Of samples collected during push-pull testing, background samples had the highest mean concentrations (0.9 mg/L), and spike samples had the lowest mean DOC concentrations (0.6 mg/L). These data are of limited usefulness because all results can be considered the same based on analytical error (Table 5.6 and Figure 5.14).

Table 5.6. Results of DOC analysis of samples from Well 1D.

Sample Description	DOC (mg/L)	Sample Description	DOC (mg/L)
July 14 (a)	0.8 ± 0.4	Test #2 Background	0.8 ± 0.4
July 14 (b)	1.0 ± 0.4	Test #2 Spike	0.6 ± 0.3
		Test #2 End of Extraction	0.6 ± 0.3
Test #1 Background	0.8 ± 0.4	Test #3 Background	1.0 ± 0.4
Test #1 Spike	0.7 ± 0.4	Test # 3 Spike	0.6 ± 0.3
Test #1 End of Extraction	1.0 ± 0.4	Test #3 End of Extraction	1.0 ± 0.4

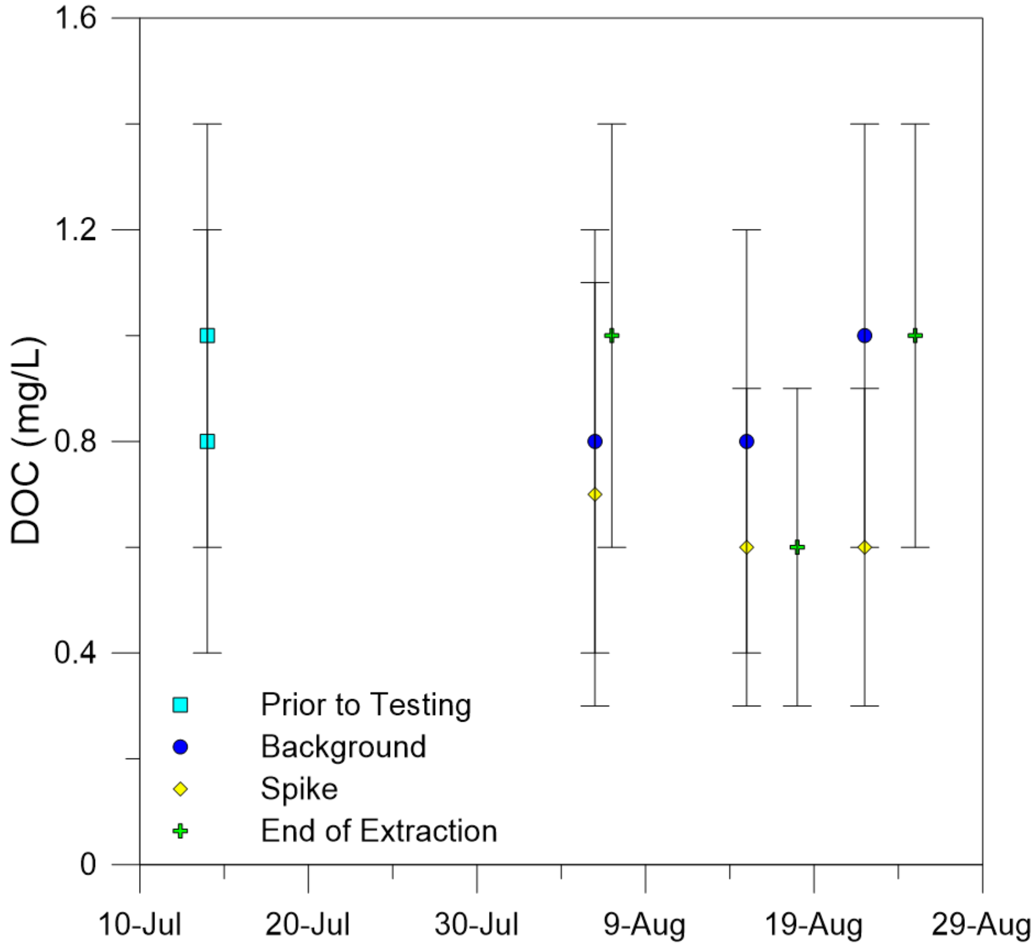

Figure 5.14. Results of DOC analysis of samples from Well 1D in 2014.

5.6 Summary

Push-pull testing conducted as part of this study indicates that DO was consumed in the saturated waste rock, but there was no evidence for the reduction of either Se or NO_3^-. Although some Se sorption/desorption cannot be ruled out, it did not result in a net change in Se mass over the duration of the extraction phase. The lack of attenuation of Se and/or NO_3^- during the push-pull tests may be the result of insufficient contact time. Alternately, no attenuation of Se and/or NO_3^- could be occurring at Well 1D in the Henretta saturated backfill. In the following section, the hydraulic and geochemical trends throughout the Henretta saturated backfill are examined using historical water level, stream flow, and chemistry data to investigate if Se and/or NO_3^- attenuation is occurring over longer time frames at this site.

6.0 DISCUSSION

Section 5.0 focussed on results obtained from testing conducted at specific wells (e.g., Well 1D). In this section, processes affecting Se and NO_3^- mobility throughout the Henretta saturated backfill will be evaluated. These discussions draw on results presented in Section 5, as well as other data (e.g., historical geochemistry sampling results, water levels). Key aspects to the interpretation of mobility of CIs at the study area are the hydraulics of the system, discussed in Section 6.1, and the geochemistry of the system, discussed in Section 6.2.

6.1 Hydraulics

The conceptual model for groundwater flow in the vicinity of Well 1D is that water within the saturated fill is derived primarily by recharge into the Henretta East waste rock pile (Figure 3.2). Precipitation infiltrates the waste rock pile and percolates vertically downward through unsaturated waste rock until it reaches the bedrock surface. At this point, the water is perched on the bedrock surface (i.e., under positive pressure) and flows laterally along the local bedrock surface to the adjacent topographic low, the saturated backfill adjacent to Henretta Lake where Well 1D is located. The recharge area of the Henretta East waste rock pile is much larger than the surface of the Henretta saturated backfill (i.e., between 11-20 times larger), and consequently inflow of water into the Henretta saturated backfill would be dominated by flow from the upslope waste rock pile. Contributions of water from the creek and/or lake are expected to be minimal at this location; evidence for this assumption is presented in Section 6.2. The thickness of the saturated zone within the Henretta East waste rock pile is likely small due to the high K of the waste rock and the average slope of the bedrock surface.

The average depth of saturated waste rock along the sloping bedrock surface below the Henretta East waste rock pile was estimated assuming a recharge rate of 730 mm/a (further discussed below), a K of 10^{-4} m/s, and an average bedrock slope of 0.24 for Figure 3.4 and 0.20 for the cross section from Golder Associates Ltd (2011) (A6, Appendix A). Based on these calculations only the bottom 0.7 (Figure 3.4) to 0.9 m (cross section from Golder Associates Ltd.) of waste rock below the Henretta East waste rock pile would need to be saturated to transmit this recharge water to the saturated backfill. This calculation also highlights the very short times required to transmit water along the sloping bedrock surface to the saturated backfill. Using the slopes, an n of 0.3, and a K fo 10^{-4} m/s, the velocity of water in the thin saturated layer in the

Henretta East waste rock pile was between 2070 (cross section from Golder Associates Ltd.) and 2480 m/a (Figure 3.4). The thin saturated layer and rapid transport of water in the saturated layer from the Henretta East waste rock pile to the Henretta saturated backfill suggests that reducing conditions are unlikely to develop in the Henretta East waste rock pile, and so CIs entering the saturated backfill from the waste rock pile will be in oxidized forms. For reductive attenuation of these CIs to occur, reducing conditions must then be present in the saturated backfill, and the reduction reactions must occur within the residence time of water in the saturated backfill.

An estimate of the rates of water movement and residence time through the saturated backfill in the vicinity of Wells 1S and 1D can be made based on rates of recharge and contributing waste rock area. The horizontal length of the contributing area of recharge into the Henretta East waste rock pile upslope of the saturated backfill was assumed to be 765 m based on Figure 3.4, and a cross section constructed by Golder Associates Ltd. (2011) (A6, Appendix A). At an assumed annual recharge rate of 600 mm/a (Barbour *et al.*, 2016), this would produce 460 m^3 of water per unit width of the dump per year. This estimate is likely low; when considering the precipitation lapse rate (+21 mm/100 m) presented in Barbour *et al.* (2016), the amount of precipitation at this location is likely closer to 730 mm/a, which would produce roughly 560 m^3 of water per unit width of the dump per year. The volume of water stored within the saturated backfill was estimated from the cross-sectional area shown in Figure 3.4 as well as the cross section from Golder Associates Ltd. (2011) (A6, Appendix A), the observed water table depths, and an assumed porosity of 0.3. Estimates of the volume of water stored in the saturated backfill were 1790 m^3 for Figure 3.3, and 893 m^3 for the cross section from Golder Associates Ltd (2011). These calculations highlight that the time to displace resident water within the saturated backfill would be between 1.6 and 3.2 a. If precipitation to the surface of the saturated backfill is added to these estimates, the residence time of water in the Henretta saturated backfill becomes 1.0 to 1.2 a, which is in agreement with the groundwater age for Well 1S from helium/tritium dating.

Based on the conceptual model, groundwater would flow down the bedrock slope into the saturated backfill in the vicinity of the screen of Well 1D (Figure 3.4). If the recharge rate within the Henretta East waste rock pile was approximately 0.73 m/a, this would produce a flow through the saturated backfill of roughly 560 m^3/a per meter width perpendicular to the flow direction and an average velocity of flow across the saturated fill of roughly 40 m/a. Flow rates can also be calculated using the observed K and gradients with the saturated backfill. For example, using the mean hydraulic gradient between Well 2 and 1D, a K of 10^{-4} m/s, and an n of 0.3, a v of 220 m/a was calculated. Using the gradient between Well 1D (using the mean hydraulic head value from water level measurements in 2014) and Henretta Lake (approximately 60 m from Well 1D, and assuming the lake surface is at an elevation of 1712 m asl), the v from Well 1D to the lake was calculated to be 950 m/a. Given a groundwater age of 1.40 a, and the gradients calculated above, the water at Well 1S could have travelled between 300 m to 1.3 km. This distance range indicates that groundwater can be sourced from the full extent of the Henretta East waste rock pile, as well as the Henretta saturated backfill (Figures 3.3, 3.4).

6.1.2. Historical Water Levels

Leveloggers installed in each of the wells at Henretta provide long-term measurements of water level and stream flow measurements (measured at HC1, downstream of Henretta Lake), and provide average daily flows in Henretta Creek (Figure 6.1). Stream flow in Henretta Creek is low in the fall and winter, but in the spring, starting roughly in May, daily flow increases. The stream flow remains elevated throughout the summer, usually decreasing in August. The melting of snow, expected to occur in the late spring/early summer, is believed to be an important source of stream flow water at this location. Multiple water level peaks were measured throughout the summer. These peaks are attributed to precipitation events, showing the spring freshet is not the only input to stream flow. Water levels at Wells 1D and 3 were also elevated in the spring and summer, and are variable during this time, again demonstrating the importance of both the spring melt and precipitation events as inputs of water at these locations (Figure 6.1).

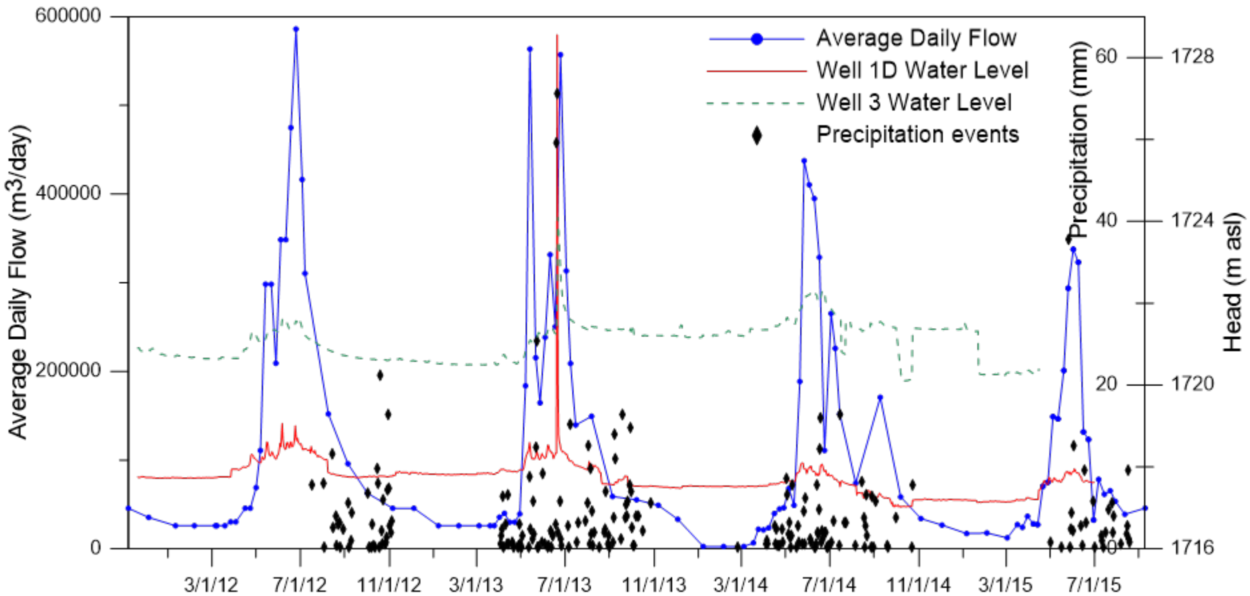

Figure 6.1. Stream flow (as average daily flow) for Henretta Creek, measured at HC1 (blue circles and line) and hydraulic head at Wells 1D (solid red line) and 3 (dashed green line). Precipitation events between March 2012 and December 2014, as measured in Sparwood, B.C. (Elevation 1137 m asl), are shown as well (black diamonds).

Large increases in water level at 1D and 3 and a peak in stream flow were measured in June of 2013 during flooding in the region (Figure 6.1); the Environment Canada Monitoring station in Sparwood, B.C. (elevation 1136.7 m asl) recorded 49.6 mm of rain on June 19, and 55.6 mm on June 20. This amount of precipitation accounts for over 1/6 of the expected annual precipitation in only two days. Given that the Henretta area is roughly 600 m higher in elevation than Sparwood, and a precipitation lapse rate of +21 mm/100 m (Barbour *et al.*, 2016), it is likely that over 230 mm of rain fell in the Henretta area over June 19 and 20. The response of each well to this large input of water is provided in Table 6.1 and Figure 6.2. Direct vertical recharge could produce a water level rise of 1 m for 100 mm of recharge if the specific yield was approximately 0.1. Wells 2, 4 and 5 show water level rises in that range. However, 1D and 1S show water level rises an order of magnitude higher. This suggests rapid transmission of water into this saturated fill from an adjacent area (Henretta East waste rock pile). This is consistent with the observation from Figure 3.4 (Cross Section B-B') that the ratio of recharge area to the area of the saturated fill adjacent to Henretta Creek is approximately 10:1.

Table 6.1. Timing and response of water levels in wells at Henretta to June 2013 precipitation event.

Well	Start of Water Level Increase	Peak Water Level	Increase in Water Level (m)	Thickness of Unsaturated Waste Rock (m)
1D	18:00, June 19	10:00, June 20	11	2.8
1S	18:00, June 19	10:00, June 20	11	2.9
2	6:00, June 20	19:00, June 20	1.5	43
3	18:00, June 19	12:00, June 21	3.0	4.0
4	17:00, June 19	6:00, June 20	0.95	1.7
5	18:00, June 19	21:00, June 20	1.7	NA

NA – Information on unsaturated thickness not available for Well 5.

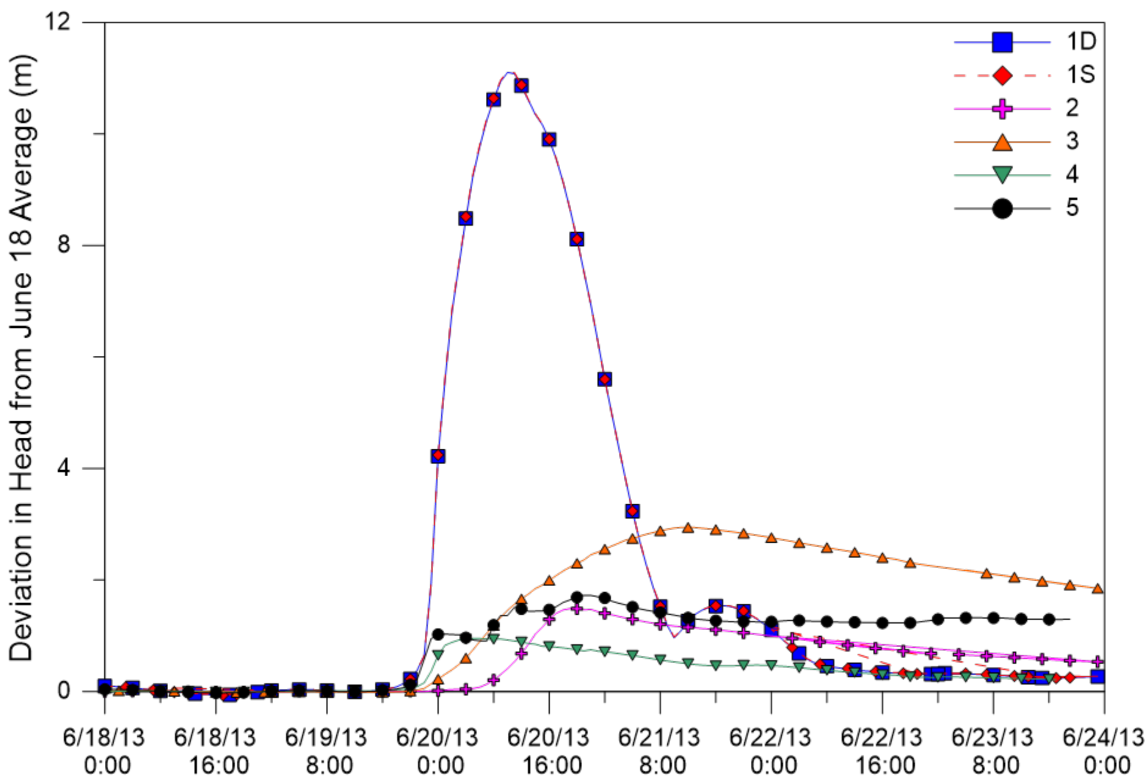

Figure 6.2. Deviation in head (from the daily average for June 18, 2013, prior to the rainfall event) for Wells 1D, 1S, 2, 3, 4, and 5. Measurements were recorded each hour by the levelogger, but for clarity symbols are only shown every 4 hours. Wells 1D and 1S follow the same trend.

Wells 1D, 1S, and 4 responded quickly to the input of water, and returned to base line quickly as well. Well 2 was the last well to respond to the precipitation event; possibly due to the greater distance between the ground surface and the water table at this location (i.e., 30 m more than at Wells 1D and 1S). Well 5 is located upstream of the Henretta saturated backfill near Henretta Creek; water levels here rose quickly and remained elevated. Well 3 is also located near Henretta Creek, but at a location further downstream. The time required to transport creek water down the valley to the location adjacent to Well 3 may be the cause of the lag in water level increase at Well 3. The slow decline in water level at Wells 5 and 3 may due to hydraulic connection to the creek, which would have had elevated water levels for some time after the rainfall event as runoff from the watershed continued to contribute water to the creek. The connection between Well 3 and Henretta Creek is explored further in Section 6.2.3.

Water level responses at Wells 2, 1D, and 1S were likely due to water infiltration on the surface of the Henretta East waste rock pile and the Henretta saturated backfill, and not related to water transferred from Henretta Creek to the waste rock. Water at Well 2 has to travel approximately 30 m farther vertically downwards to reach the water table than at Wells 1S and 1D and therefore peaked later than the other wells. Based on this difference and the difference between the start of water level increase, water was advancing through the unsaturated waste rock at a rate of about 2.5 m/h at Well 2 during this time. The difference in timing and level of response to this major hydrological event highlights the different hydrologic systems operating at this location (i.e., importance of creek water input versus important of infiltration input, rapid movement of infiltration water through waste rock). This event is believed to be responsible for the shift in chemistry at Well 1D (discussed below).

6.2 Geochemistry

Temporal relationships between Se, SO_4^{2-}, and NO_3^- can be useful indicators of physical and geochemical processes occurring in the saturated backfill (e.g., Se reduction, denitrification, NO_3^- flushing). All three of these species are released from waste rock; Se and SO_4^{2-} as a result of the flushing of oxidation products from the waste rock (Day *et al*., 2012; Kennedy *et al*., 2012; Hendry *et al.*, 2015), and NO_3^- from flushing of residual ANFO (Bailey *et al.*, 2013; Dockrey *et al*., 2015; Mahmood *et al.*, 2016).

Nitrate concentrations remain elevated only as long as it takes to flush the initial pore-volume of the waste rock, and can decrease within anoxic saturated fills as a result of denitrification. As a consequence of these different processes, it has been shown that the SO_4^{2-}/NO_3^- ratio can remain constant at about 10 (Bailey *et al.*, 2013; Kuzyk *et al.*, 2015) during flushing of the NO_3^-, afterwhich SO_4^{2-} concentrations remain elevated relative to NO_3^- as SO_4^{2-} continues to be produced from the oxidation of waste rock while NO_3^- concentrations decrease as a result of flushing. Selenium and SO_4^{2-} concentrations within oxic waste rock effluent can remain elevated, or even increase with time, due to ongoing oxidation within the unsaturated waste rock. Under oxic conditions, the Se/SO_4^{2-} ratio should remain constant at about 10^{-4} (Day *et al.*, 2012). Under anoxic conditions, such as those in a saturated backfill environment, this ratio has been shown to approach 10^{-6}, presumably due to the sequestration of Se, while SO_4^{2-} continues to behave conservatively (Dockrey *et al.*, 2015). Low Se/SO_4^{2-} ratios are also associated with lower correlations between Se and other products of weathering (e.g., Mg and Ca) (Dockrey *et al*., 2015).

Chemistry for Wells 1D, 1S, 2, 3, and 4 as well as Henretta Creek monitoring location HC2 are provided in Figure 6.3, along with average daily discharge for Henretta Creek measured at HC1. Well 5 had low levels of CIs, with concentrations below detection for NO_3^- (< 0.0050 mg/L as N) and Se (< 0.00010 mg/L), and a mean SO_4^{2-} concentration of 19.2 mg/L (standard deviation: 3.8, n = 5).

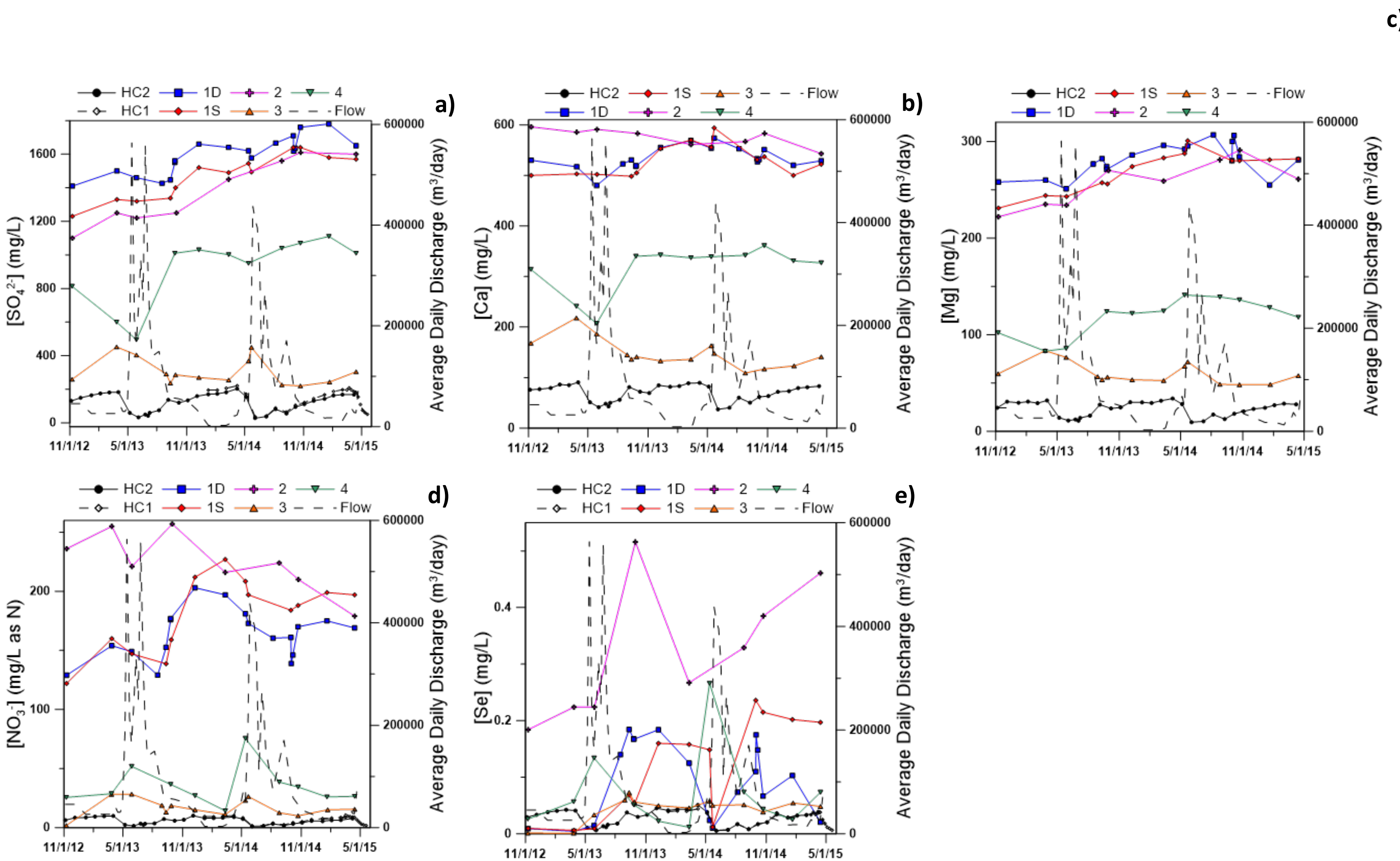

Figure 6.3. SO_4^{2-} (a), Ca (b), Mg (c), NO_3^- (d), and Se (e) over time for Wells 1D, 1S, 2, 3, 4, HC1 (not shown on (b) or (c)), and HC2 (symbols represent sampling event). Flow in Henretta Creek (measured at HC1) is also shown in all plots (black dashed line).

Well 2, located at the intersection of the Henretta East waste rock pile and the Henretta saturated backfill, is assumed to represent oxic waste rock effluent, and has relatively high concentrations of solutes presented in Figure 6.3. Henretta Creek (HC2) flows into the Henretta saturated backfill from higher in the mountain valley, where no mining has occurred, and has lower concentrations of solutes presented in Figure 6.3. Concentrations of CIs are similar in HC1 (lower portion of creek) and HC2 (upper portion of creek); however, given the high flow rates in the creek relative to the discharge into the creek from the waste rock, it is difficult to define the flow and mass load contributions from the waste rock into the creek.

Concentrations measured at Wells 3 and 4 generally plot between the concentrations of Well 2 and HC2, and could possibly represent a mixture of waste rock effluent and creek water (Figure 6.3). Concentrations at HC2 are lowest at times of high flow, and highest at times of low flow (Figure 6.3). Concentrations of all solutes presented in Figure 6.3 (except Se) at Well 3 respond oppositely to those at HC2; when there are elevated concentrations at HC2, the concentrations at Well 3 are low, and when concentrations are low at HC2, they are high at Well 3. Concentrations (expect Se) in Well 3 are initially high as flow increases in May (both 2013 and 2014), and decreases throughout the summer. It is possible during times of high flow in Henretta Creek, water from the creek migrates through that backfill material towards Well 3, resulting in decreasing concentrations at Well 3 during the summer months.

Concentrations of SO_4^{2-}, Ca, and Mg at Wells 1D and 1S are similar to those of Well 2, suggesting that the water at Wells 1D and 1S is primarily sourced from waste rock (Figure 6.3). If both NO_3^- and Se behave conservatively in the saturated backfill, concentrations of these two CIs at Wells 1D and 1S should also be similar to those at Well 2. This, however, is not the case; concentrations of both NO_3^- and Se at Wells 1D and 1S differ form Well 2 (Figure 6.3).

6.2.1 Nitrate

Nitrate concentrations at Wells 1D and 1S were lower than those at Well 2 from the start of sampling (November, 2012) until September 2013 when NO_3^- concentrations in 1D and 1S began to rise (Figure 6.3 (d)). A possible explanation for this rise is that prior to September 2013 denitrification was occurring at 1D and 1S, leading to a decrease in NO_3^- concentrations relative to the concentrations observed at Well 2. The large precipitation event in June of 2013 resulted in an influx of fresh waste rock effluent, possibly disrupting the reducing conditions present at 1D and 1S and therefore disrupting denitrification. This process could have resulted in elevated NO_3^- concentrations after June 2013. The NO_3^- concentrations at 1D and 1S remained elevated until May of 2014. After this time, the NO_3^- concentration of 1D was lower than that of both 1S and 2, indicating that the conditions necessary for denitrification may be present at 1D again, but not 1S. It is likely that since Well 1D is screened at a deeper interval, and has a thicker saturated zone above the well screen, it thus has stronger reducing conditions than Well 1S. The time between the start of increase in NO_3^- concentrations and the start of decrease at Well 1D was roughly 8 months (Figure 6.3 (d)). By the end of the sampling period (April 2015), NO_3^- concentrations had still not returned to the pre-flood concentrations. This indicates a lengthy recovery time for this system after a perturbation. This may be problematic if the saturated backfill is to be used as a water treatment mechanism as perturbations can disrupt the attenuation of NO_3^- for long periods of time, leading to increases in NO_3^- concentrations leaving the saturated fill.

Two different SO_4^{2-}/NO_3^- signatures exist in the Henretta saturated backfill: one with a value around 6.1, representing fresh waste rock effluent (Well 2), and one with a value around 22 representing creek water (HC1 and HC2) (Figure 6.4 (a)). Well 3 plots between the creek values and Well 2 values in Figure 6.4, indicating that the concentrations of NO_3^- and SO_4^{2-} at Well 3 are a result of mixing between the creek water and waste rock effluent.

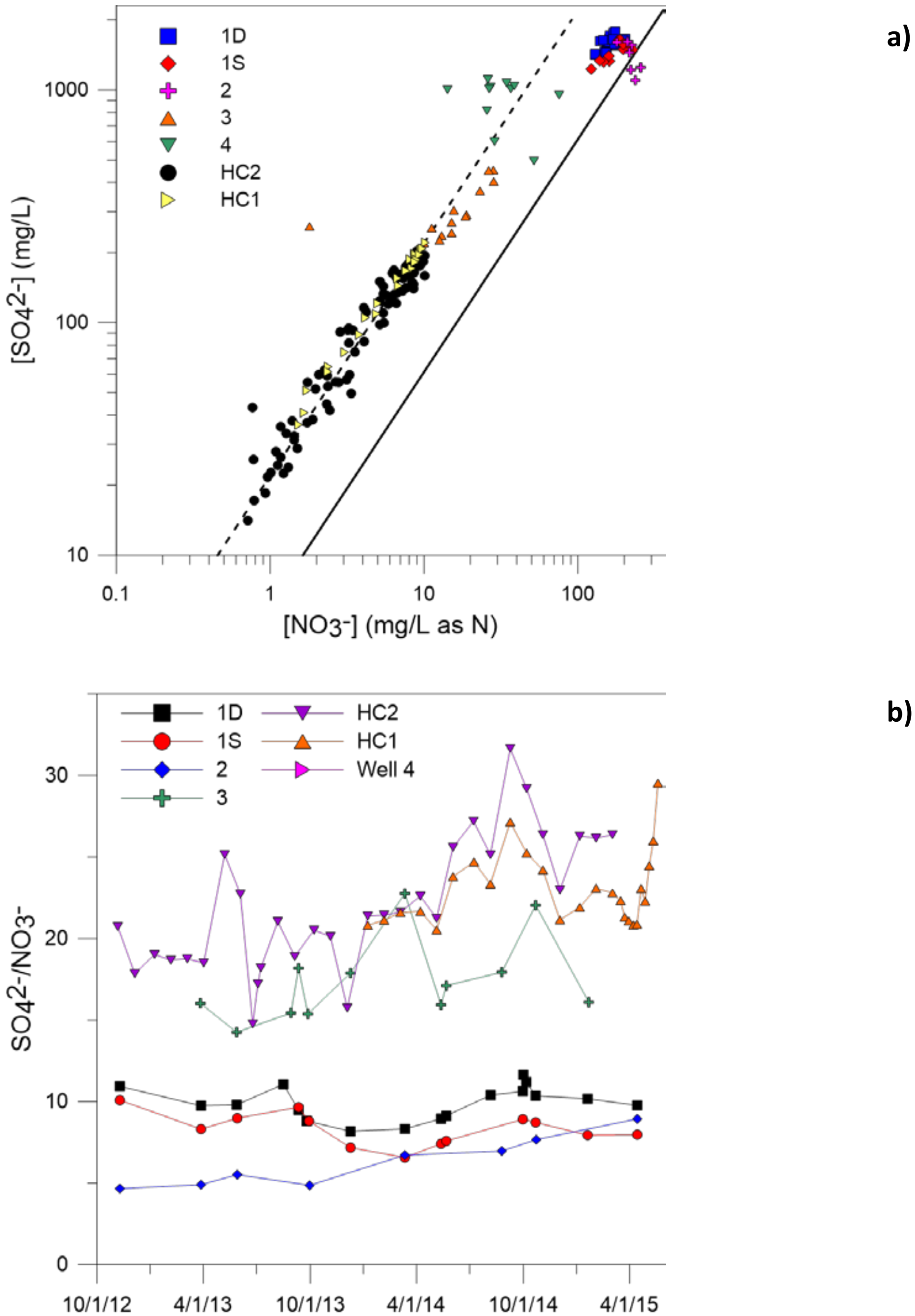

Figure 6.4. Log-log plot of SO_4^{2-} versus NO_3^- for Wells 1D, 1S, 2, 3, 4 and Henretta Creek monitoring locations HC1 and HC2 (a). Dashed line is a constant SO_4^{2-}/NO_3^- ratio of 22, solid line is a constant ratio of 6.1. Symbols represent sampling events. SO_4^{2-}/NO_3^- ratio over time for Wells 1D, 1S, 2, and 3 as well as Henretta Creek monitoring locations HC1 and HC2 (b). Symbols represent sampling events. Well 4 data was not included due to high peak SO_4^{2-}/NO_3^- ratios (approximately 70).

The ratio of SO_4^{2-}/NO_3^- for Well 1D (Figure 6.4 (b)) remains relatively constant over time, ranging from 8.2 to 11.6, with a mean value of 9.8. Well 1S has similar SO_4^{2-}/NO_3^- ratio values, and values at Well 2 are slightly lower. These ratios suggest that NO_3^- concentrations in the Henretta East waste rock pile and Henretta saturated backfill at Well 1D are still dominated by flushing of NO_3^- from blast residue, as the ratio has not decreased over time and is near the expected value of 10. Although the peak SO_4^{2-}/NO_3^- ratios prior to November 2012 are unknown, the increasing SO_4^{2-}/NO_3^- ratios observed in Wells 1D and 1S prior to August 2013 are also correlated in time to lower NO_3^- concentrations prior to increasing to approximately 200 mg/L after August 2013 (Figure 6.3 (d)). This could suggest that some NO_3^- reduction was occurring within the vicinity of 1D prior to August 2013.

During push-pull tests conducted by Starr and Gillham (1993) and Trudell *et al*. (1986) in sandy agricultural soils in southern Ontario, Canada, denitrification occurred quickly once excess DO was removed from the system. Denitrification does not appear to occur quickly in the Henretta saturated backfill despite the absence of DO, as evidenced by the slow (and ongoing) recovery to reducing conditions at Well 1D after the concentration increase following the June 2013 flooding (Figure 6.3 (d)) and absence of measureable denitrification in both push-pull testing (Test 3, Well 1D, 2014 (Figure 5.9)) and NO_3^- isotopes (Figure 5.14). Schwientek *et al.* (2008) assumed that since DOC concentrations at their study area rarely exceeded 1 mg/L, alternative electron donors were used in denitrification. They concluded that NO_3^- was indirectly oxidizing pyrite, and this process may proceed very slowly (Schwientek *et al.*, 2008). Similar conditions exist at Henretta, where DOC concentrations were 1.0 mg/L or lower at Well 1D (Figure 5.15), and the slow reaction kinetics of anaerobic pyrite oxidation coupled to denitrification may be the reason that no denitrification was observed during push-pull testing (Schwientek *et al*., 2008). Denitrification coupled to pyrite oxidation requires a microbial catalyst to occur at significant rates (Jorgensen *et al*, 2009), and so it is also possible that the appropriate microbial community has not re-established itself after the June 2013 flooding in the area.

6.2.2 Selenium

Concentrations of Se at Wells 1D and 1S are lower than at Well 2 (Figure 6.3 (e)). Increases in Se concentration occurred at Wells 2, 1D, and 1S after the June 2013 flooding event. After recovery from the large peak in the summer of 2013, Se concentrations at Well 2 steadily increase in a similar way to the SO_4^{2-} concentration trend at Well 2 (Figure 6.3 (a) and (e)). The rate of increase for SO_4^{2-} at Well 2 over the sampling period was 0.56 mg/L/day, and was 0.0003 mg/L/day for Se (ignoring the large concentration increase at September 30, 2013). Unlike Well 2, Se concentrations at Wells 1D and 1S are variable over time, exhibiting both increases and decreases in concentration.

Surface waters in the study area (HC1 and HC2) are consistent around a Se/SO_4^{2-} value of 2.0×10^{-4} (Figure 6.5). Well 2 samples are also consistent around this value, indicating that Well 2 water is oxic, as previously assumed. Samples from Wells 1D, 1S, and 4 (and 3, generally to a lesser extent) fall to the left of this value (dashed line, Figure 6.4 (a)), indicating that Se concentrations are lower than expected for the given SO_4^{2-} concentrations, and this is not the result of mixing between waste rock effluent and creek water, as dilution by creek water would also result in a decrease in SO_4^{2-} concentration.

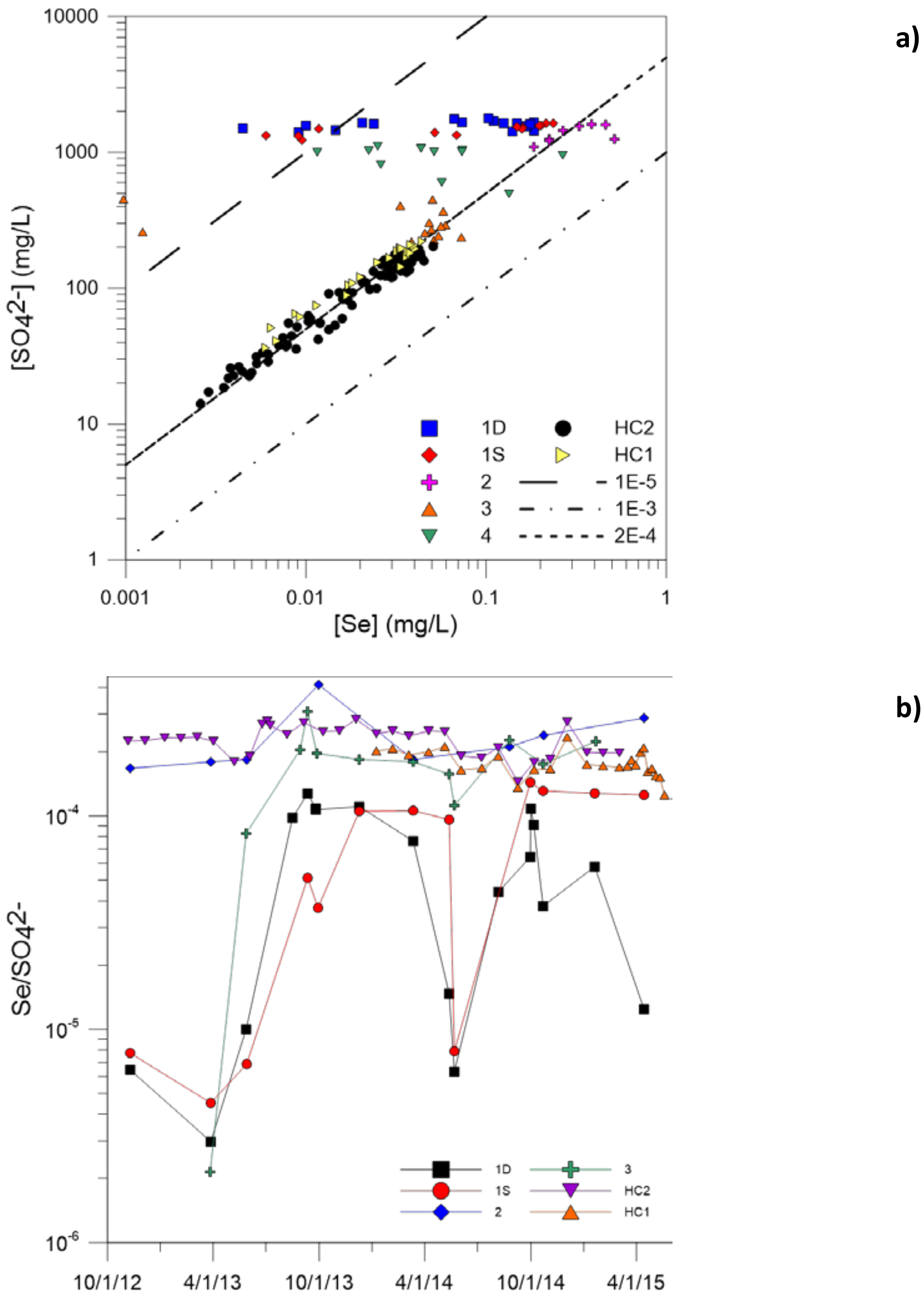

Figure 6.5. Log-log plot of SO_4^{2-} versus Se for Wells 1D, 1S, 2, 3, and 4 as well as Henretta Creek monitoring locations HC1 and HC2 (a). Lines represent constant SO_4^{2-}/Se ratios. Symbols represent sampling events. Se/SO_4^{2-} (Log scale) versus time for Wells 1D, 1S, 2, 3, and 4 as well as Henretta Creek monitoring locations HC1 and HC2 (b).

The ratio of Se/SO_4^{2-} at Well 1D is consistent with the SO_4^{2-}/NO_3^- pattern in that prior to August 2013 the Se/SO_4^{2-} ratio was between 10^{-5} and 10^{-6} rising to 10^{-4} after August 2013 (Figure 6.4 (b)). This pattern suggests some Se attenuation could have occurred near Well 1D prior to

August 2013, but these waters were displaced with fresh waste rock effluent around that date and have since proceeded toward a slow re-establishment of pre-flood conditions.

Chemistry in the Henretta saturated backfill is variable with time, with both large increases and decreases in CIs occurring at different times at different wells. Table 6.2 presents the geometric mean concentration, standard deviation, minimum and maximum concentrations, and median concentration for Se, NO_3^-, and SO_4^{2-} for groundwater samples collected from Well 1D between November 2012 and April 2015.

Table 6.2. Range, mean, and median values for Se, NO_3^- (as N), and SO_4^{2-} for Well 1D, November 2012 to April 2015 (n=18).

Species	Geometric Mean Concentration (mg/L)	Standard Deviation (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Median Concentration (mg/L)
Se	0.0587	0.0686	0.0045	0.184	0.107
NO_3^-	162	21	129	203	165
SO_4^{2-}	1589	110	1410	1780	1619

Although there is variability in the chemistry for all three CIs listed in Table 6.2, the variability in Se is the greatest. For Se, the standard deviation represents 117% of the mean Se concentration, whereas for NO_3^- it is 13% and 7% for SO_4^{2-}. Possible explanations for the large variability in the concentration of Se are: (1) reduction of Se, (2) differences in the source/sink(s) of Se or SO_4^{2-}, (3) mixing of waters with different Se signatures, and (4) sorption/desorption of Se on mineral surfaces in the saturated backfill. These possibilities are discussed in the following sections.

6.2.2.1 Selenium Reduction

Although Se/SO_4^{2-} ratios in the range of 10^{-6} may indicate the occurrence of Se reduction, the high concentrations of NO_3^- (mean concentration: 162 mg/L as N) at Well 1D suggest that Se reduction is not occurring. A lack of Se reduction could be explained by a number of reasons: (1) NO_3^- reduction is slightly more thermodynamically favourable than Se reduction (Bao *et al*., 2013; Dockrey *et al*., 2015; Enviromin Inc., 2013), and therefore Se reduction will likely only occur when there is no or low concentrations of NO_3^-, (2) NO_3^- may inhibit Se reduction (Bailey *et al*., 2012; Dockrey *et al*., 2015), and (3) NO_3^- has the potential to oxidize Se in pyrite or other reduced forms of Se (Bailey *et al*., 2012; Schwientek *et al*., 2008).

Samples with reduced Se/SO_4^{2-} ratios are not correlated to periods of low NO_3^- concentration (Figure 6.6). This suggests that the control on Se concentration at Well 1D is not reduction, or reduction is occurring in the presence of contrary of high concentrations of NO_3^-.

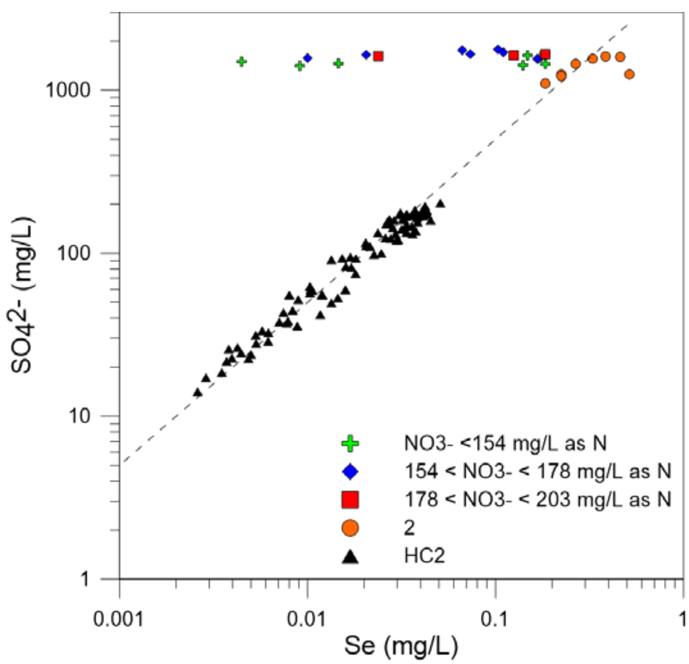

Figure 6.6. Log-log plot of SO_4^{2-} versus Se for Well 2 (orange circles) and HC2 (black triangles). SO_4^{2-} and Se data for Well 1D is also shown based on NO_3^- concentration; $NO_3^- \leq 154$ mg/L as N (green crosses), $154 < NO_3^- \leq 178$ mg/L as N (blue diamonds), and $178 < NO_3^- \leq 203$ mg/L as N. The dashed line represents a constant Se/SO_4^{2-} ratio of 2.0×10^{-4}.

Push-pull Tests 2 and 3 at Well 1D in 2014 provided no evidence that Se reduction was occurring throughout the duration of the tests (Figures 5.7 and 5.9), although Pourbaix diagrams for these tests do indicate that Se^{4+} should be the dominant form of Se. Selenium speciation data for these tests indicate that there were low concentrations of Se^{4+} and mixing between spike and formation water had occurred, but do not indicate that Se was being reduced in the saturated backfill in the vicinity of Well 1D over the duration of the push-pull tests (Figures 5.11 and 5.12).

6.2.2.2 Availability of Selenium and Sulfate

Differences in the occurrence and availability of Se in the waste rock compared to SO_4^{2-} could also lead to the variable Se/SO_4^{2-} ratios over time. There is variability in both the abundance of Se in host rock as well as the distribution of different types of host rock within the waste rock, and therefore variability in the concentration of Se in waste rock (Hendry *et al.*, 2015).

Gypsum represents a potential sink for SO_4^{2-}, but has not been shown to incorporate Se at Teck sites, and was slightly undersaturated in samples modelled using PHREEQC (n=11, samples collected between November 2012 and April 2015). The average SI value for gypsum was -0.08. This value is negative and indicates that there is no gypsum precipitating at this location, and it is not acting as a control on SO_4^{2-} concentrations. The value is close to 0 though, suggesting that at times the system may be either in equilibrium or saturated with respect to gypsum. If there was saturation, the precipitating gypsum would serve as a sink for SO_4^{2-} (and not Se or NO_3^-), lowering the concentrations of SO_4^{2-} in the aqueous phase. In this case SO_4^{2-} could not be used as a conservative species, and ratios of Se/SO_4^{2-} and SO_4^{2-}/NO_3^- would be of limited usefulness, unless the timing and amount of SO_4^{2-} being removed from the aqueous phase could be quantified.

6.2.2.3 Mixing of Water with Different Se Signatures

Both the waste rock effluent from the Henretta East waste rock pile (Well 2) and Henretta creek water (HC2) have similar Se/SO_4^{2-} signatures, and do not explain the lower Se/SO_4^{2-} periodically occurring within the Henretta saturated backfill. Another possible source water is the Henretta Ridge Pit water, but unfortunately no water from this location was collected as part of this study. Information on the Se/SO_4^{2-} signature of the Henretta Ridge Pit water would be useful in determining if this water is contributing lower concentration Se water to the Henretta saturated backfill.

6.2.2.4 Selenium Sorption

Partitioning of Se through sorption processes could explain the changing Se concentrations at Well 1D through time. Speciation data indicates that both Se^{4+} and Se^{6+} are present in the waters of the saturated backfill (Test 2, Well 1D, 2014 (Figure 5.11)). Because Se^{4+} has a higher affinity for sorption sites than Se^{6+}, changes in the oxidation state of Se would have an impact on the amount of sorption expected. Because the oxidation of Se proceeds slowly (Guo *et al.*, 1999), it is possible that some of the previously immobile reduced forms of Se could be oxidized to Se^{4+} and not to the higher oxidation state of Se^{6+}. This Se^{4+} could be then be sorbed to mineral surfaces in the saturated backfill. Furthermore, both Se^{4+} and Se^{6+} can be adsorbed onto organic matter, apatite, Fe oxyhydroxides, and aluminum and other metal oxides (Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010; Das *et al.*, 2013). Some factors listed in the literature as having an effect on Se sorption include pH (Figure 6.7) and competition for sorption site from anions or organic acids (Figure 6.8).

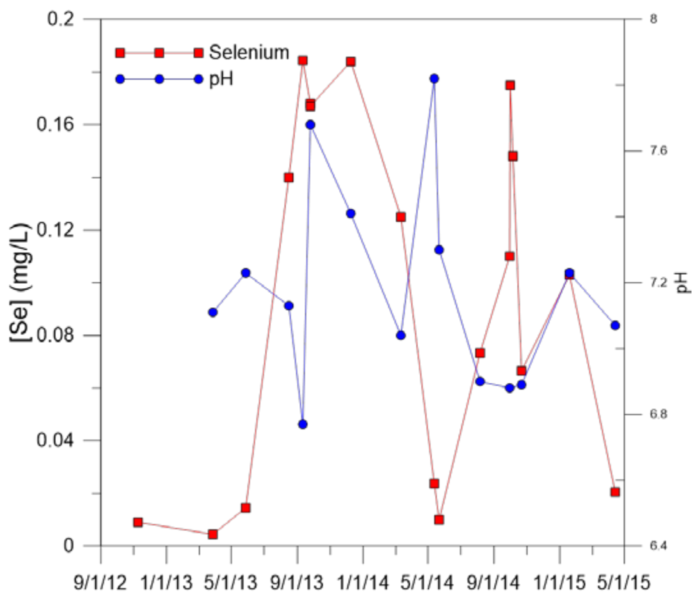

Figure 6.7. Selenium concentrations (red square) and pH (blue circle) at Well 1D with time. Symbols represent sampling events.

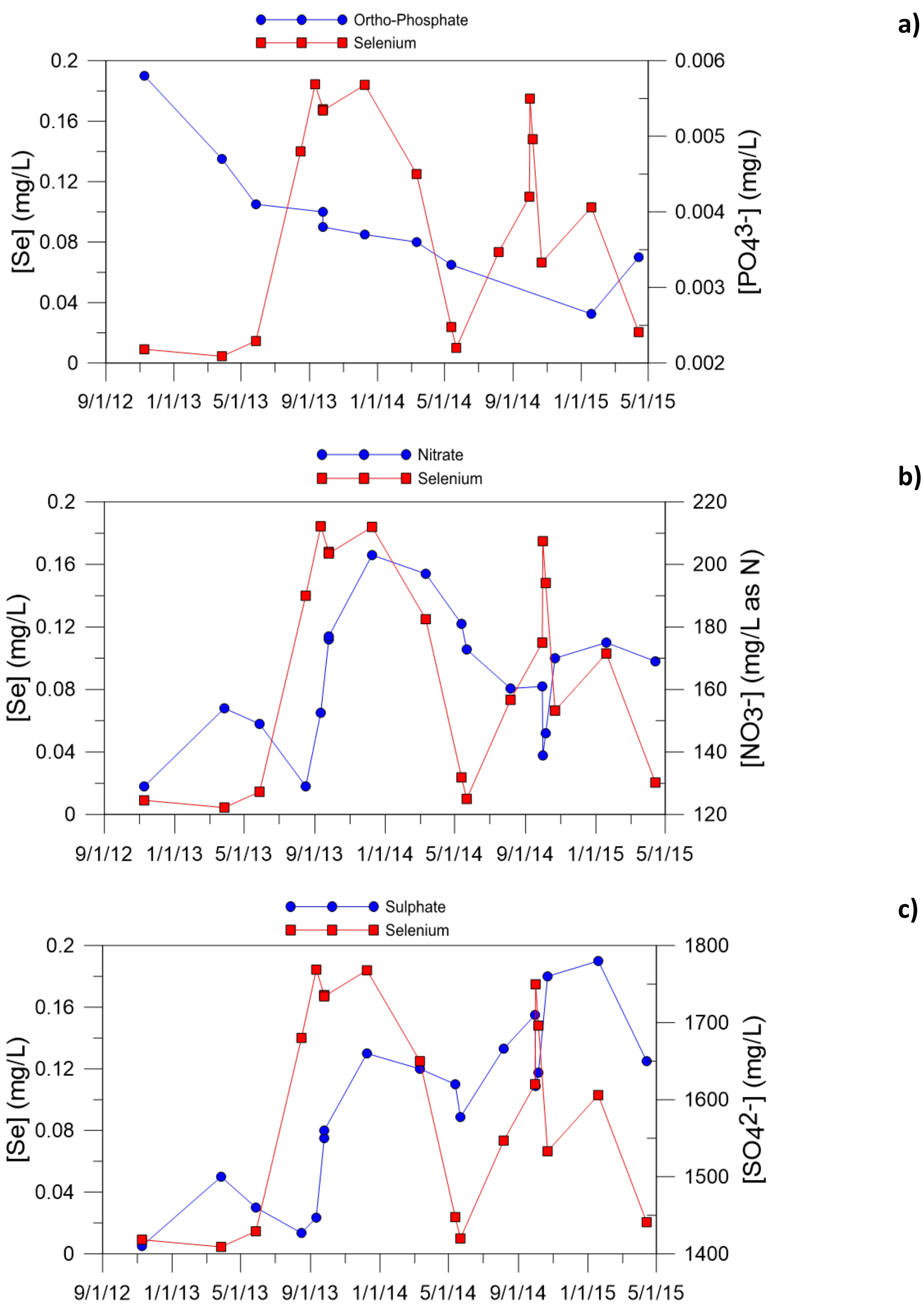

Figure 6.8. Selenium concentrations (red square) and ortho-phosphate (a), nitrate (b), and sulphate (c) (all blue circles) over time at Well 1D. Symbols represent sampling events.

As pH decreases, Se sorption has been shown to increase due to an increase in surface affinity for anions, but this relationship is not evident at Well 1D (Blaylock *et al*., 1995; Fernández-Martínez and Charlet, 2009; Zhang and Moore, 1996) (Figure 6.7).

Competition for sorption sites from anions such as PO_4^{3-}, NO_3^-, SO_4^{2-}, and/or organic acids has been shown to decrease Se sorption (Blaylock *et al*., 1995; Fernández-Martínez and Charlet, 2009; Gerla *et al*., 2010; Wijnja and Schulthess, 2000). There is no information on the presence or concentration of organic acids, but none of anions listed above are correlated to the changing Se concentrations over time (Figure 6.8).

No relation between Se concentrations and the discussed factors effecting Se sorption were found at Well 1D. Some sorption may have occurred during push-pull testing at Well 1D, but based on percent recovery and normalized concentrations, this sorption was either minimal, or desorption also occurred during the push-pull tests, resulting in no overall attenuation of Se throughout the duration of the test. This does not necessarily mean that Se sorption/desorption processes were not occurring, but rather that no direct evidence for its occurrence were observed as part of this study.

7.0 SUMMARY AND CONCLUSIONS

There are water quality concerns in the Elk Valley, BC. Increases in the concentration of Se and NO_3^- in natural waters down stream of open pit coal mines have been observed (Dessouki and Ryan, 2010; McDonald and Strosher, 1998). Saturated backfills represent a possible mechanism for the attenuation of both Se and NO_3^- through reduction, but if they are to be used as a treatment mechanism, there needs to be improved knowledge on the hydrologic and geochemical conditions within saturated backfills, and how these conditions change through time. This study examines the hydraulic and geochemical conditions at a small, saturated backfill at Teck's Fording River Operation. A method to test the rates of DO, Se, and NO_3^- reduction was developed and employed. Although the method deployed demonstrated the ability of the study area to attenuate DO, no attenuation of NO_3^- or Se was observed during testing. Despite the absence of NO_3^- or Se attenuation at this study site, the method employed, or similar testing, may be a useful tool at study areas with longer residence times.

Objectives of this research were to: (1) identify the geochemical and hydrologic conditions in a saturated backfill, (2) develop and test a field protocol to quantify *in situ* geochemical reactions in a saturated backfill environment (i.e., push-pull test), (3) characterize the biogeochemical controls on Se and NO_3^- attenuation in the saturated backfill using push-pull testing, and (4) evaluate the potential for the geochemical regime to enhance Se and NO_3^- removal. To accomplish the first objective, an investigation into well hydraulic and temporal geochemical trends was conducted. The conclusions from these investigations are provided in Sections 7.1 and 7.2. Push-pull testing was conducted to achieve the final three objectives. Conclusions from these tests are discussed in Section 7.3.

7.1 Groundwater Flow

The saturated backfill in the vicinity of Well 1D has a thick saturated zone, with approximately 36.5 m of water above the top of the well screen, and sits at the toe of the Henretta East waste rock pile (Figures 3.3, 3.4). The Henretta East waste rock pile is expected to have a thin (<1 m) saturated layer, and groundwater is thought to flow along the surface of the bedrock down gradient towards the saturated backfill. Pneumatic slug testing at Well 1D resulted in a geometric mean K estimate of 7×10^{-5} m/s. Groundwater ages for Wells 3 and 1S at Henretta were < 1.04 and <1.40 a respectively. There is likely a thin saturated layer at the waste rock/bedrock interface in the Henretta East waste rock pile, and although it may take years for infiltrating water to move through the unsaturated waste rock, it is likely transported more quickly once in the saturated layer.

Groundwater velocities of 220 and 950 m/a were estimated using the hydraulic gradient between Wells 2 and 1D, and between 1D and the surface of Henretta Lake, respectively, suggesting water at Well 1S (with an age of 1.40 a) could have travelled between 300 to 1300 m. Estimates indicate that the residence time of water in the Henretta saturated backfill is likely ≤ 1.4 a, based on flushing from the Henretta East waste rock pile and infiltration of precipitation on the surface of the Henretta saturated backfill.

Water levels in wells and flow in Henretta Creek show that the spring melt is an important hydrological event. Water level changes throughout the summer show a response in the wells and creek to precipitation events as well.

The presence of active groundwater flow in the saturated backfill may be limiting the development of strong reducing conditions, microbial communities, and/or residence times necessary for the occurrence of denitrification and Se reduction. A study area with a longer groundwater residence time would likely be a better candidate for the occurrence Se and NO_3^- reduction and for the reduction to be measurable using push-pull tests.

7.2 Geochemistry Trends

Eighteen samples collected between November of 2012 and April of 2015 were used to examine trends in Se, SO_4^{2-}, and NO_3^- concentrations in the saturated backfill. The SO_4^{2-}/NO_3^- ratio at Well 1D maintained a relatively constant ratio of approximately 10 suggesting the Henretta East waste rock pile and Henretta saturated backfill are still being flushed of blast residue. Ratios of SO_4^{2-}/NO_3^- were approximately 22 for Henretta Creek and 6.1 for Well 2; these values likely represent the end members at the study area, with Henretta Creek representing fresh water, and Well 2 representing oxic waste rock effluent. Wells 1D and 1S has SO_4^{2-}/NO_3^- values closer to that of Well 2, whereas Well 3 had a value closer to that of Henretta Creek. These data suggest greater mixing between waste rock effluent and creek water at Well 3 than Wells 1D and 1S. Possible attenuation of NO_3^- through denitrification may explain periods of low NO_3^- concentrations at Wells 1S and 1D, but flooding in June of 2013 may have disrupted denitrification by flushing the saturated backfill with oxic water. Neither nitrate isotopes nor push-pull testing indicate that any measurable denitrification was occurring at the time of sampling/testing.

The Se/SO_4^{2-} ratio at Well 1D varied over time, ranging from 3.0×10^{-6} to 1.2×10^{-4} with a mean value of 3.8×10^{-5}. This ratio is expected to be constant in oxic waters, but may decrease in anoxic waters due to the attenuation of Se. Reductive attenuation of Se is likely not occurring at Well 1D due to the presence of high concentrations of NO_3^-, which, among other things (e.g., presence of appropriate microbial communities), can inhibit Se reduction. Further evidence that Se reduction is not occurring over the push-pull testing period is provided by push-pull testing and Se speciation data. Mixing with Henretta Creek water was not found to be a strong influence on water chemistry at Well 1D. The Henretta Ridge Pit water is another potential source of water, but no samples from this location were collected as part of this study. Alternatively, Se may be attenuated through sorption processes, or the changing Se/SO_4^{2-} could be due to differences in the abundance and/or availability of Se and SO_4^{2-} in the waste rock.

Selenium and NO_3^- concentrations with time behaved differently than SO_4^{2-}, Mg, and Ca concentrations at Well 1D. The cause of for this difference is not evident. The lack of understanding in these temporal changes, along with the temporal variations themselves, on Se and NO_3^- chemistry may be problematic if saturated backfills are to be used as water treatment tools, as remobilization of Se and NO_3^- is a risk.

7.3 Push-Pull Tests

Push-pull tests conducted at Well 3 yielded low tracer recoveries even for short (~19 h) reaction times, highlighting one of the difficulties with conducting push-pull tests in waste rock; high levels of dilution. Push-pull testing was then performed at Well 1D where recoveries were higher. Three push-pull tests were conducted at Well 1D in August of 2014. Reactive tracers and reaction times for each of the three tests were: (1) DO, 19 h, (2) Se^{6+}, 67 h (3) Se^{6+} and NO_3^-, 66 h. There was no evidence from these tests that Se of NO_3^- was being attenuated. The results of each test are described below.

During the extraction phase of Test 1, the concentration of DO rapidly decreased to below the detection limit. Concentrations of conservative tracers remained elevated for the duration of the extraction phase. A decrease in the concentration of DO in excess of that due to dilution occurred as a result of DO utilization as an electron acceptor in the formation. The k was estimated to be 0.32 h^{-} using the first-order reaction equation (Equation 4.10). This value is greater than k estimates for Well 3 from push-pull tests in 2013 (0.03 h^{-}) and 2014 (0.07 h^{-}). The methods for estimating k outlined in Haggerty *et al.* (1998) and Schroth and Istok (2006) were employed, but due to the absence of early time data (i.e., data between the end of injection and 19.4 h (completion of the purging of one well and sandpack volume)), did not provide reliable results.

The initial three samples from the extraction phase of Test 2 yielded lower normalized concentrations of Se compared to the conservative tracers, potentially indicating that Se was being attenuated in the saturated backfill. For the remaining seven samples, Se concentrations were within the range of, or slightly elevated above, the conservative tracers. Reductive attenuation of Se would yield lower normalized Se concentration throughout the entire duration of the extraction phase. A possible explanation for the measured trend could be sorption of Se onto mineral surfaces (e.g., Fe oxyhydroxides) in the saturated backfill. Sorption would remove Se from the aqueous phase, resulting in the initially lower normalized Se concentrations (compared to the conservative tracers), and back diffusion could explain the increase in normalized Se concentrations later in the extraction phase. Percent recovery calculations do not indicate that any Se was attenuated in the formation during this push-pull test.

A Pourbaix diagram constructed from push-pull Test 2 measurements suggests that Se^{4+}, which has a higher affinity for sorption sites than Se^{6+}, should be the dominant species in background and extraction samples. Speciation data shows that the maximum Se^{4+}/Se^{6+} value was less than 0.3, and therefore the majority of Se is Se^{6+} and not Se^{4+}. Since the majority of Se is present in the highest oxidation state, it is unlikely that Se reduction is occurring.

A similar trend in Se concentration with time to that observed in Test 2 was measured during Test 3; initial Se samples plotted below the normalized concentrations of the conservative tracers. After these initial samples, normalized Se concentrations were within the range of normalized concentrations for the conservative tracers. Normalized concentrations of NO_3^- plotted within, or slightly above, the range of conservatives tracers for the entire extraction phase, indicating that NO_3^- behaved conservatively during this test. Percent recoveries for all tracers were similar for Test 3, indicating that no attenuation of Se or NO_3^- occurred during this test.

Pourbaix diagrams constructed from Test 3 measurements for Se and NO_3^- suggest that both Se and N should be present as reduced species for both the background and extraction phase samples. Selenium speciation data for Test 3 only had one (of nine) sample with Se^{4+} concentration above detection limits, unlike speciation data for Test 2, where all ten samples had Se^{4+} concentrations above detection. Speciation data for both tests show no indication of Se reduction, but instead indicate a mixing trend between the spike water and formation water. Nitrate isotope data provides evidence that nitrification from ANFO has likely occurred, but does not indicate that any measurable NO_3^- reduction is occurring at Wells 1S, 1D, or 3.

No evidence for the occurrence either Se reduction or denitrification was found during push-pull testing at the Henretta saturated backfill. Push-pull testing conducted at multiple wells (Wells 3 and 1D) was done in order to compare reaction rates at different locations in the saturated backfill to examine how position in the backfill and saturated thickness affect reduction rates. Unfortunately, the low recovery at Well 3 and no observable reduction of Se or NO_3^- at Well 1D do not allow for this comparison to be made. Testing methodology carried out in this research could be used to assess the potential of other saturated backfills to attenuate Se and NO_3^- if sufficiently long reaction times can be achieved. Suggestions for criteria to select sites where push-pull tests may be of use to measure Se and/or NO_3^- attenuation are provided in Section 7.4.

7.4 Recommendations for Future Work

Push-pull testing can be a useful tool to examine attenuation of reactive constituents in saturated waste rock environments. The following are recommendations for conducting push-pull or similar testing in saturated waste rock.

7.4.1 Site Selection

Information on temporal and spatial changes in geochemistry at the study area are important for a number of reasons, and so having a record of site geochemistry for a number of years prior to the onset of testing is ideal. A site should have stable hydraulic and geochemical conditions through time; if there are large seasonal fluctuations in geochemistry, attenuation may only occur at certain times, and remobilization may be an issue, making the site unattractive for treatment of redox sensitive constituents. Additionally, having an accurate value for background concentrations of tracer species is important in normalized concentration calculations, and fluctuations in geochemistry can increase uncertainty in this value.

Parameters such as Eh and pH can be measured prior to conducting push-pull tests, and along with water temperature and other chemical species present, can used to construct Pourbaix diagrams. These diagrams will indicate which form of a chemical species should be present based on thermodynamics, and indicate if reduction of the species of interest is probable. If the diagrams do not indicate that reduced species of the reactive tracers are expected, it is likely that the site is not a good candidate for measuring reductive attenuation through push-pull testing.

For many species, either isotope or speciation analysis can be performed to determine if reactions are occurring. For example, NO_3^- isotopes can be used to examine if denitrification is occurring if the isotopic value of the source NO_3^- is known. In the case of mining, ANFO is often the dominant source of NO_3^-, and so, by knowing the isotopic value of the ANFO, the nitrification of the ANFO and any potential denitrification will be evident in the $\delta^{18}O$ and $\delta^{15}N$ values of the groundwater. Speciation analysis of Se can determine the concentrations of Se^{6+} and Se^{4+} in the sample water. If the sample is predominately Se^{6+}, it is unlikely that Se reduction is occurring. Tools such as these can be used to assess if reductive attenuation is likely to be occurring at the study area. Ideally, isotope or speciation analysis would indicate that attenuation is occurring, and the only limiting factors in being able to determine the reaction rate from push-pull tests are dilution and reaction kinetics (i.e., is it possible to have a sufficiently long reaction time).

Active groundwater flow past test wells increases the amount of dilution occurring, and decreases the reaction time. Longer reaction times may be necessary to observe and quantify reaction rates of some reactive species, depending on reaction kinetics, and so the ideal setting for a push-pull test would in a location with a thick saturated layer (for the development of reducing conditions) and stagnant, or very slowly moving groundwater (i.e., a bathtub scenario). This would allow for stable hydraulic conditions and long reaction times.

The ideal monitoring well for conducting a push-pull test would be one with no sandpack. The goal of a push-pull test is to assess the ability of a formation to attenuate a constituent; the larger the sandpack, the larger the volume of spiked water that remains in the sandpack and not the formation, and so is not representative of reaction rates occurring in the formation.

7.4.2 Conducting Push-Pull Tests

Prior to conducting push-pull tests with reactive tracers, it may be desirable to conduct tests using only conservative tracers in order to quantity dilution in the formation surrounding the test well. Reaction times for subsequent tests can then be selected based on this preliminary testing. Large volumes of spiked water are desirable as they allow for increased reaction times and for the investigation of a larger formation volume. At the same time, injection times should be kept short relative to reaction and extraction times to minimize the time difference between the first and last particle injected. Analytical solutions for push-pull data often assume that spike injection time is short relative to the reaction and extraction times, and so if these methods are to be employed, it is important to keep the spike injection duration to a minimum.

If there is a large volume of standing water in the test well, a packer should be used to seal off the water column above the screen, and injecting and extraction should occur below the packer. This would prevent diffusion from the standing water in the well to the water being extracted for analysis. If a packer is not available, a bailer or other sampling method could be used to sample water in the test well above the well screen to determine well water chemistry.

In addition to monitoring the chemistry of the reactive tracers used in a push-pull test, monitoring concentrations of possible reaction products could function as an independent check of the reaction rate using the rate of product formation, rather than the rate of reactant consumption. For example, if denitrification is occurring, measuring N_2 and other N species could allow for additional calculations of the rate of NO_3^- consumption, and can also be used to identify if the reduction in NO_3^- concentration is indeed from denitrification, of if DNRA or other NO_3^- transformation reactions are occurring (Schürmann *et al.*, 2003). Isotopically enriching the tracer would enable one to use isotopes to trace the mixing and transformations occurring, as was done in Schurmann *et al.* (2003).

Multiple samples of pre-test chemistry should be collected to ensure that background values are well constrained. A bailer or low flow pump could be used to take periodic samples from within the well during the reaction time, to provide chemistry data between the end of injection and start of extraction. This is especially important if reaction times are long and the Haggerty *et al.* (1998) or Schroth and Istok (2006) solutions are to be used for data analysis.

7.4.3 Larger Scale Testing (Tracer Test)

A larger scale assessment of a formation's attenuation potential could be made using multiple wells. An injection well up gradient could be used to inject spiked water, and one or more observation wells down gradient could be used for extraction. This type of testing would examine a known portion of the formation (i.e., the distance between the injection and observation wells) and likely allow for long reaction times.

7.4.4 Pneumatic Slug Testing

An apparatus with a regulator, such as a canister of compressed gas, would likely allow for more control over the injection of pressured air, and therefore the initial displacement. With more control over initial displacement, multiple tests with the same initial displacement could be conducted and compared, and the levelogger could be placed at a depth just slightly deeper than the initial displacement. Placement of the levelogger closer to the water table would help to minimize the effects of water column acceleration on the levelogger readings (Butler *et al*., 2003). Higher frequency readings (>0.5 sec) would increase the accuracy of K estimates, and are particularly important in formations with high K values, where response to the slug occurs quickly. Since there is the potential for very high K values in the saturated waste rock, the K of the sandpack may limit the response times in the well to slug testing. An evaluation of the influence of the sandpack on the estimated K values from slug tests is recommended to better understand this issue.

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APPENDIX A: Well Schematics, Levelogger Data, Additional Push-Pull Data

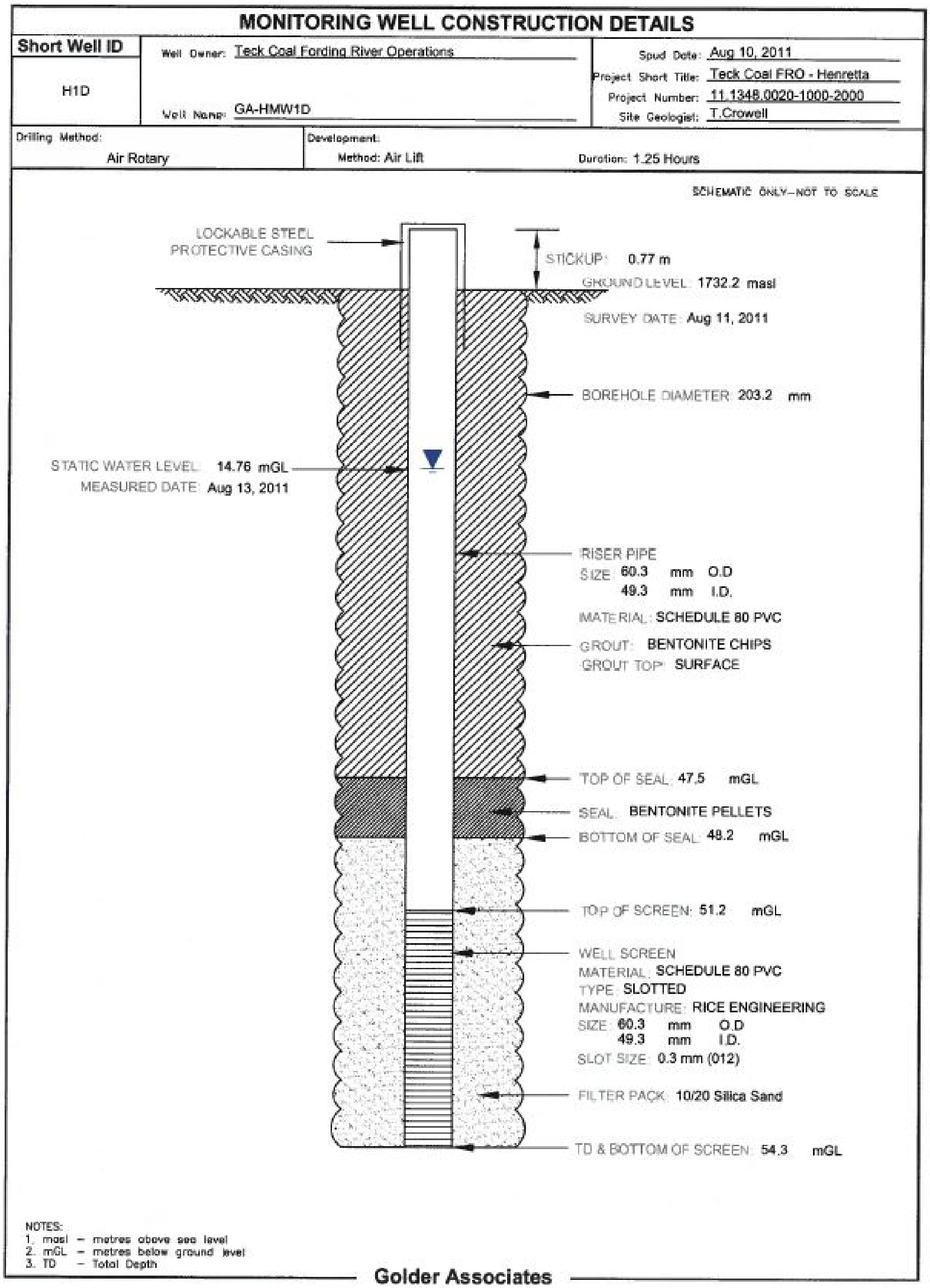

Figure A1. Schematic of well 1D (Golder Associates Ltd., 2011).

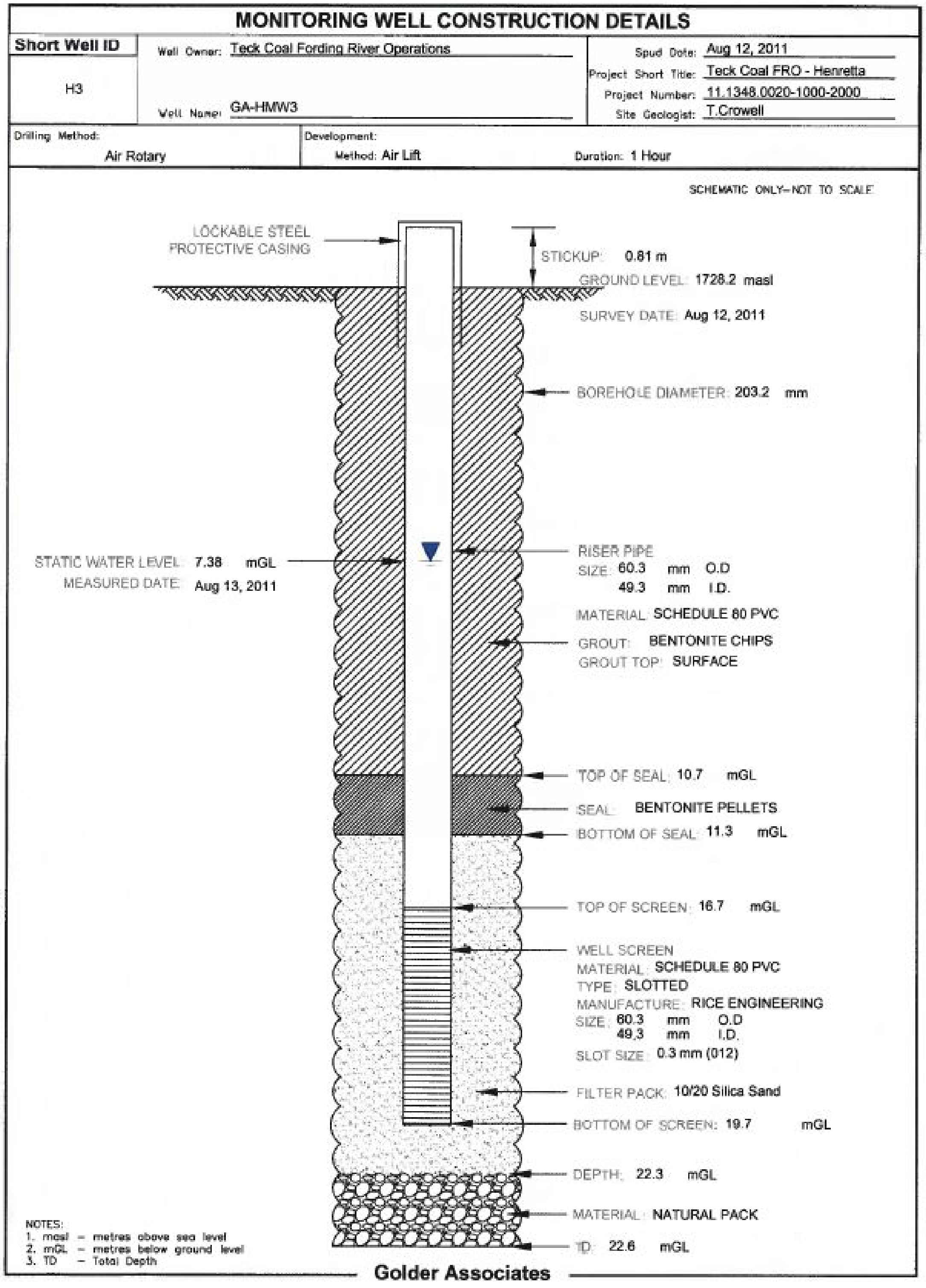

Figure A2. Schematic of well 3 (Golder Associates Ltd., 2011).

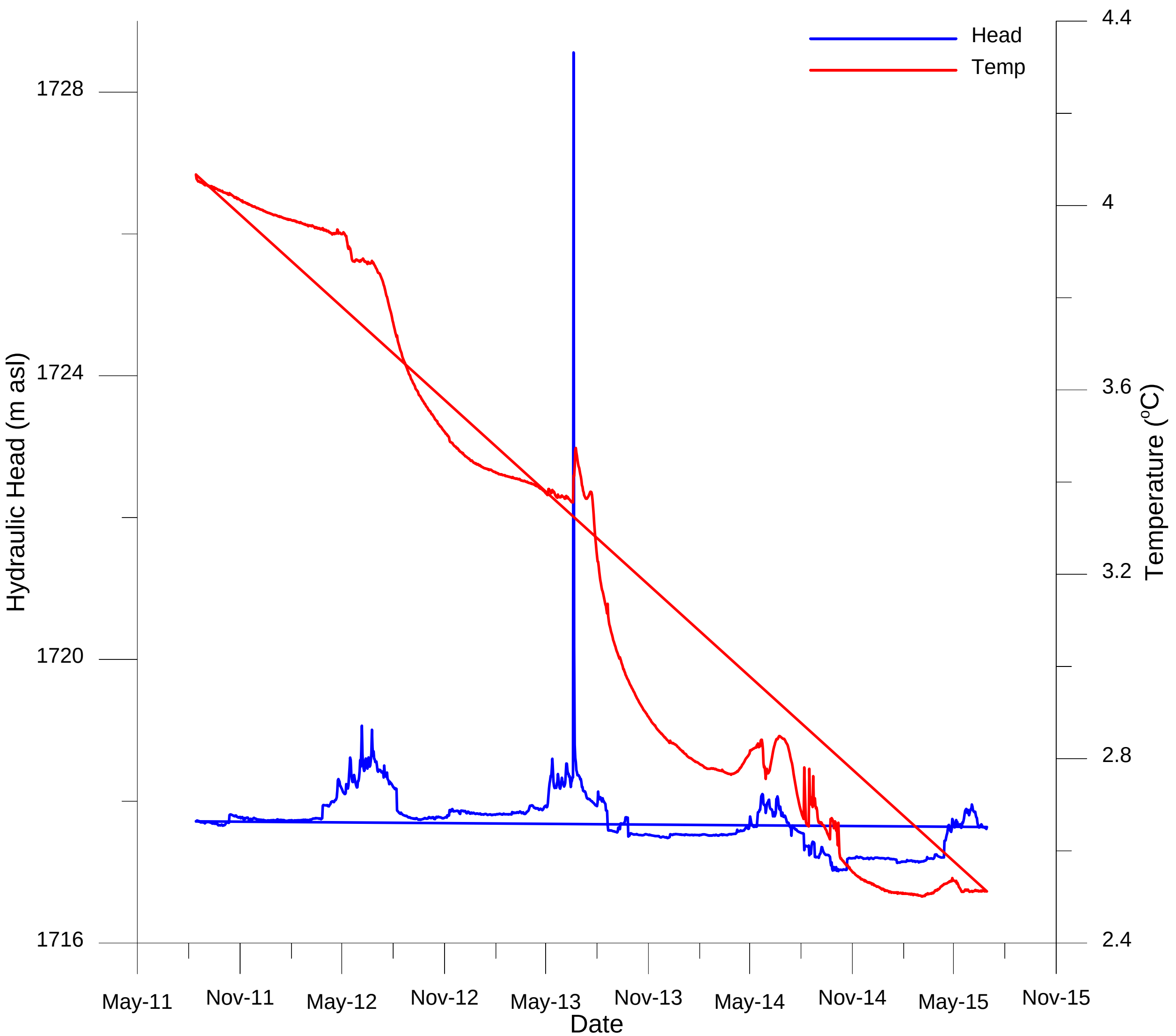

Figure A3. Hydraulic head and water temperature data for well 1D.

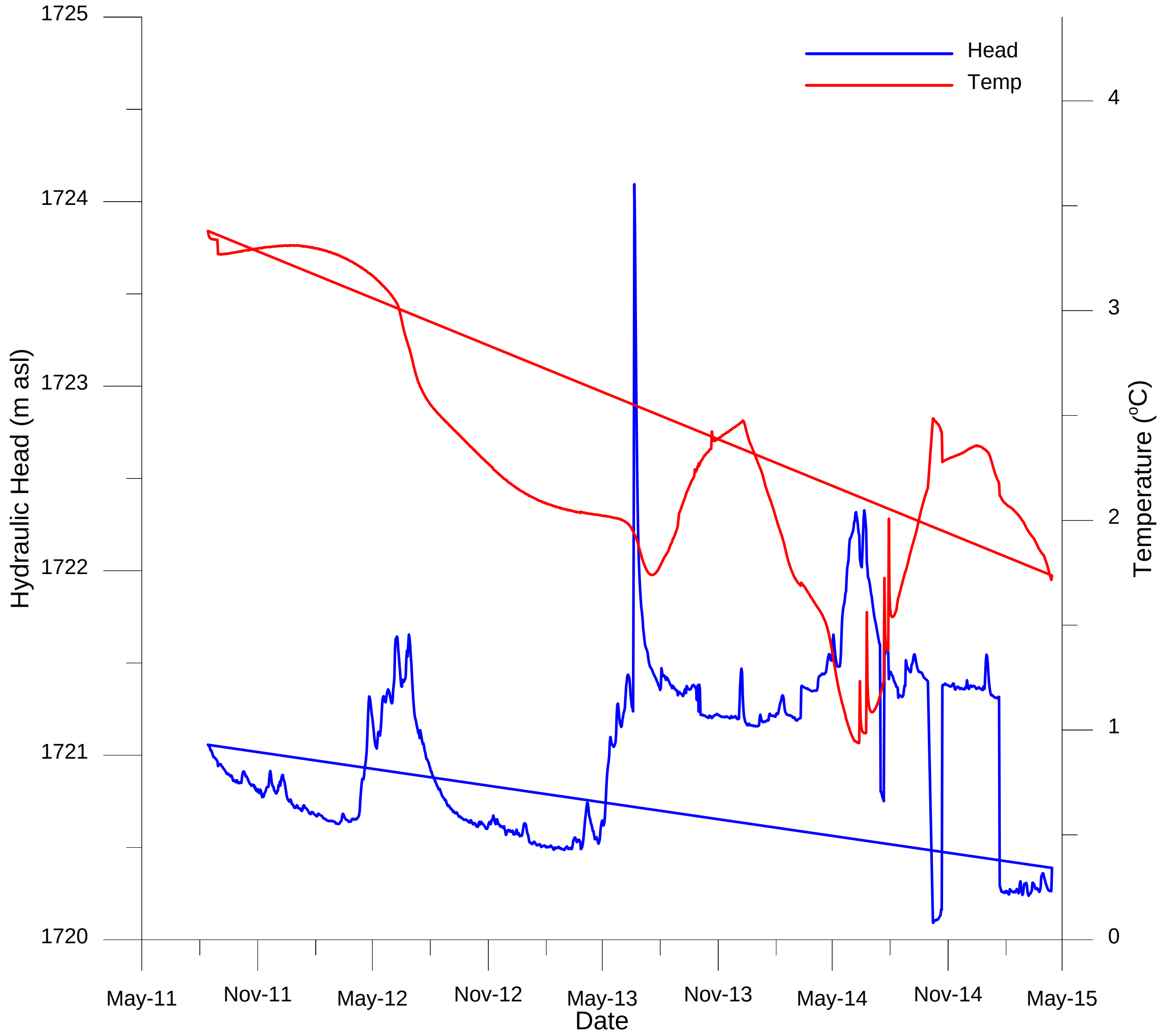

Figure A4. Hydraulic head and water temperature data for well 3.

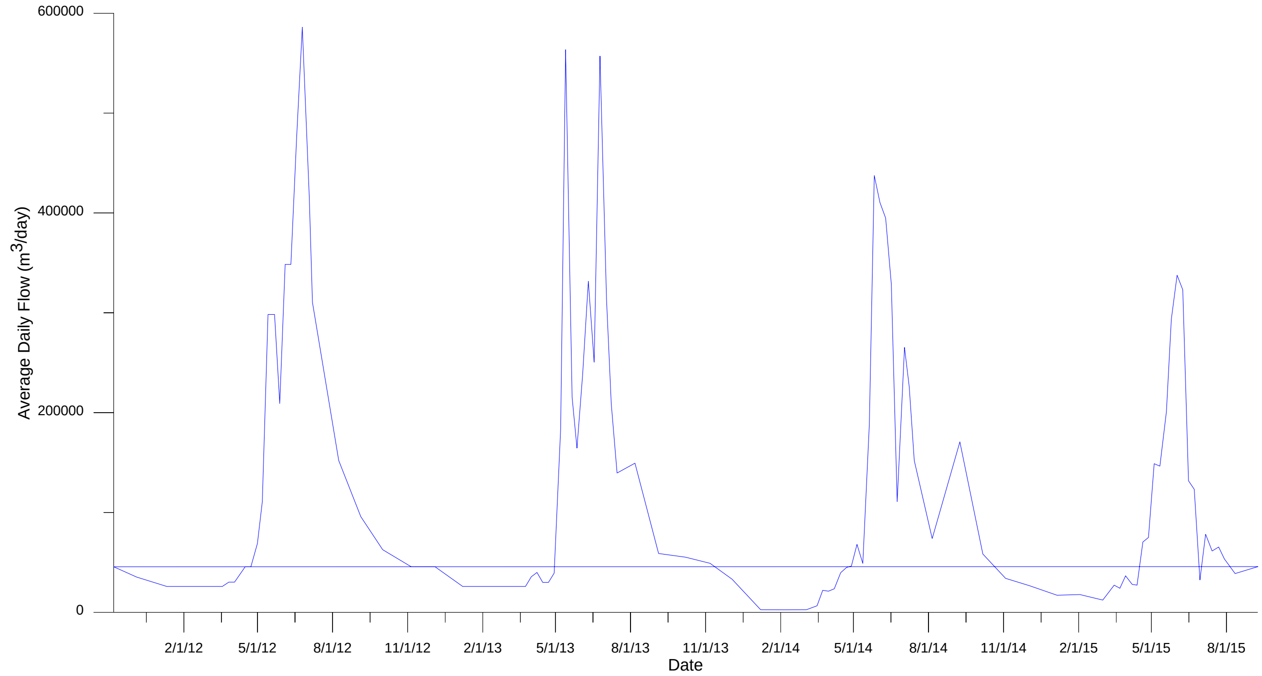

Figure A5. Average daily flow as measured at HC1.

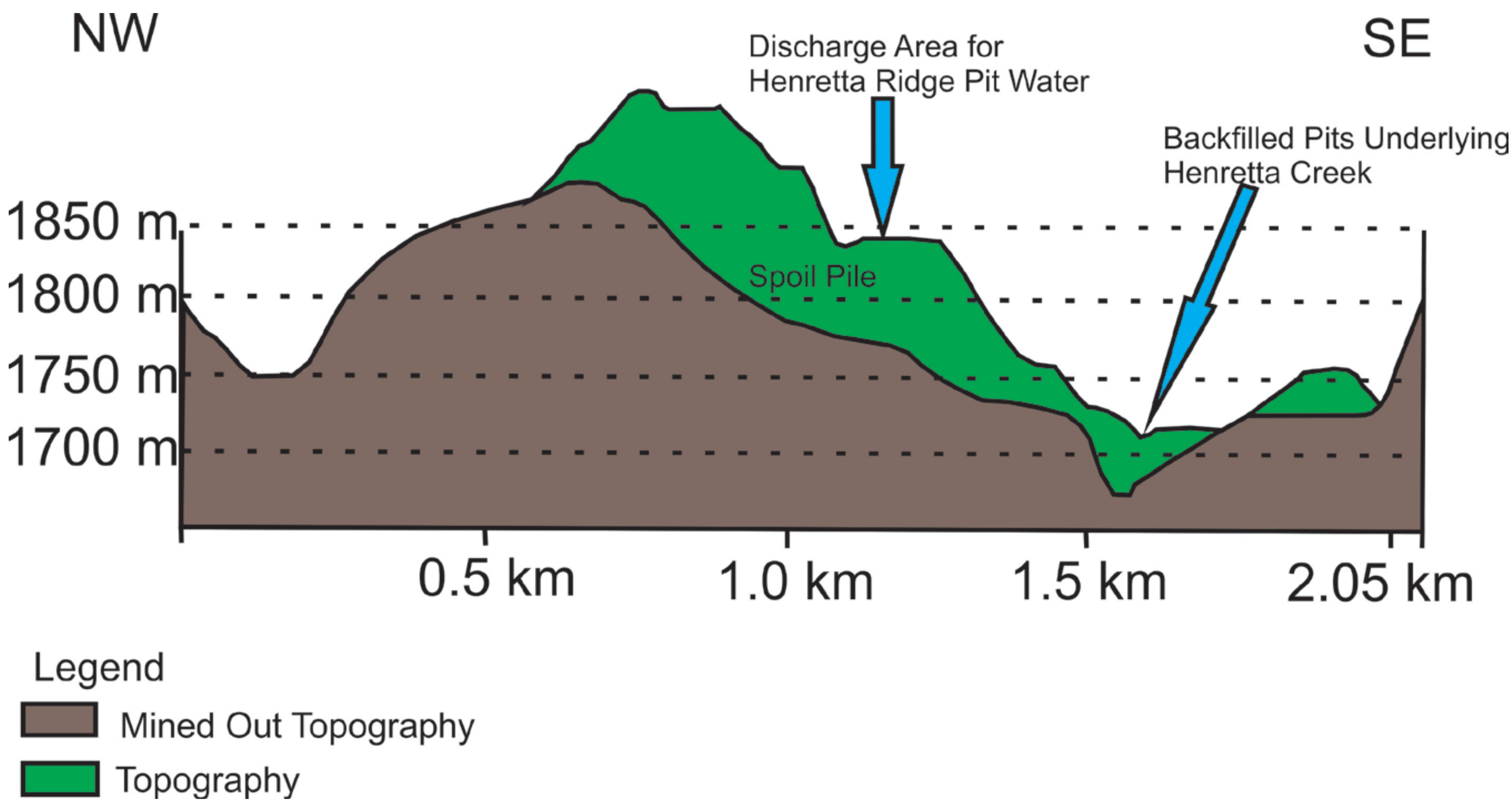

Figure A6. Cross section of the Henretta East waste rock pile and Henretta saturated backfill (After Golder Associates Ltd., 2011).

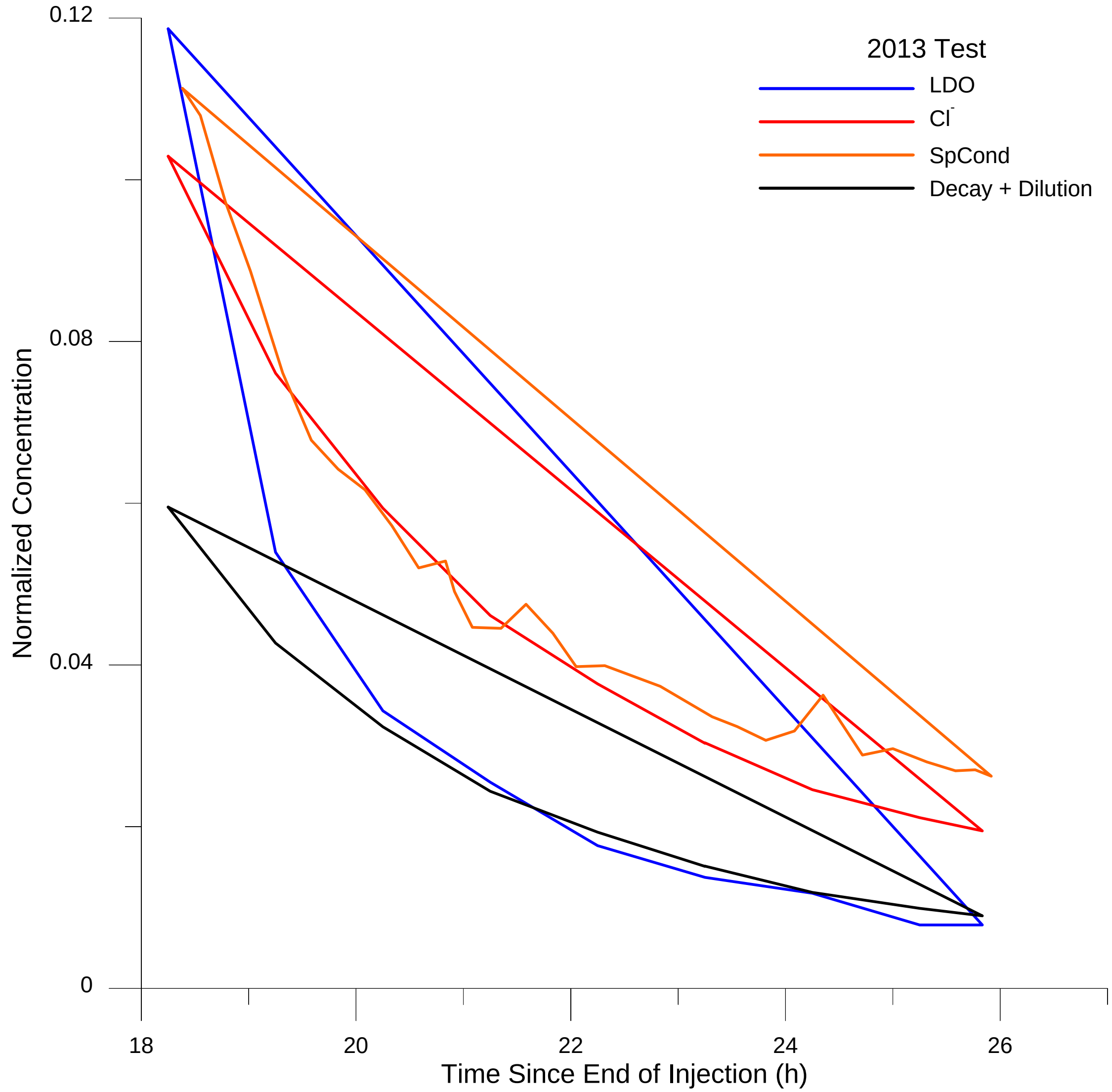

Figure A7. Results of final push-pull test at Well 3 in 2013. Decay + Dilution line is calculated from the dilution factor of Cl and the estimated first order reaction rate of DO.

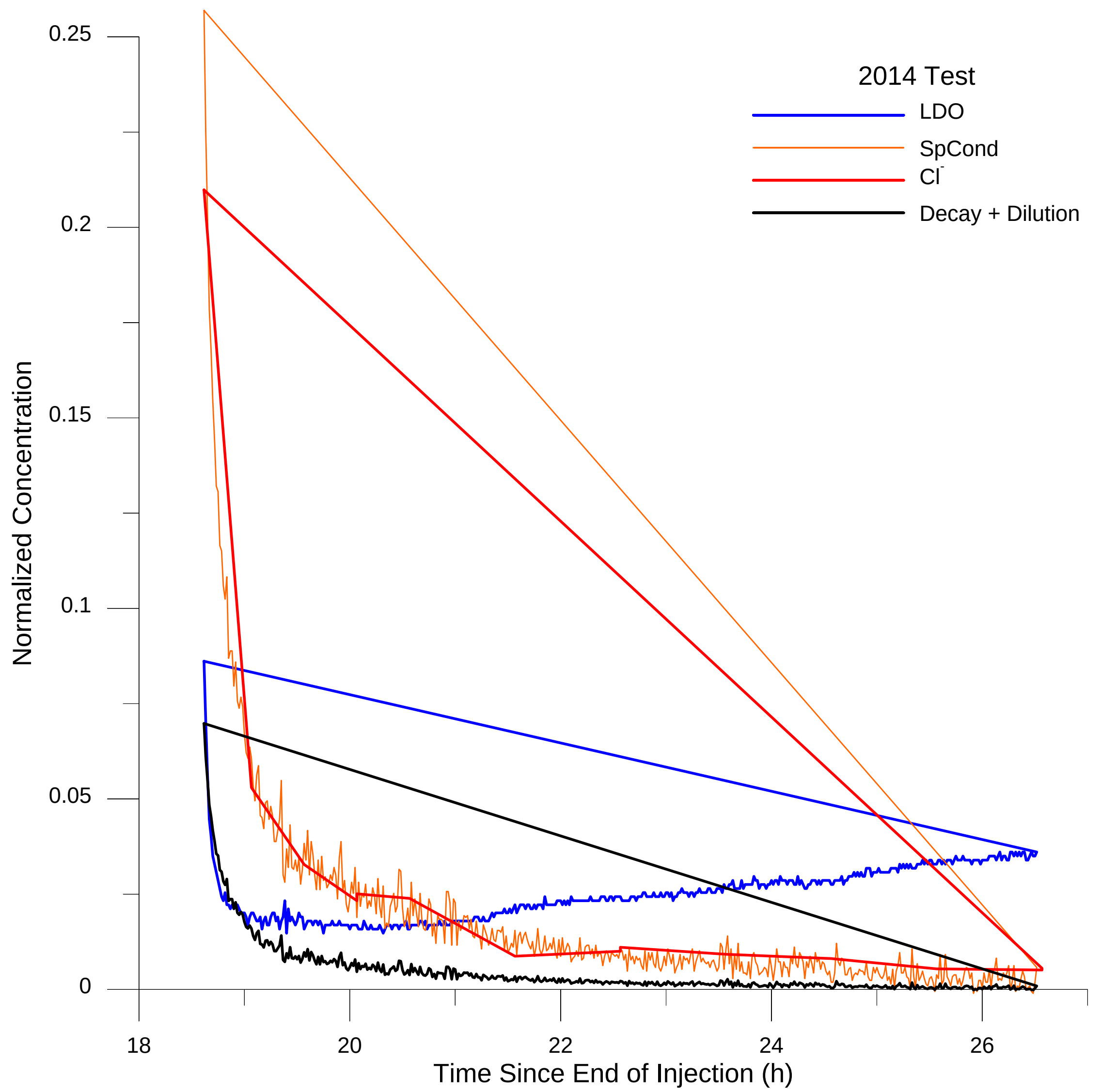

Figure A8. Results of final push-pull test at Well 3 in 2014. Decay + Dilution line is calculated from the dilution factor of Specific Conductivity (SpCond) and the estimated first order reaction rate of DO.

APPENDIX B: Slug Test Data

Table B1. Levelogger and Barologger data for pneumatic slug testing on May 22 at well 1D.

Test #1				Test #2				Test #3				Test #4				Test #5			
Time	**ms**	**Level**	**Baro**	**Time**	**ms**	**Level**	**Baro**	**Time**	**ms**	**Level**	**Baro**	**Time**	**ms**	**Level**	**Baro**	**Time**	**ms**	**Level**	**Baro**
10:52:00	0	18.8924	-0.4485	10:57:30	0	18.9445	-0.4521	11:02:30	0	18.9627	-0.4536	11:07:00	0	18.9717	-0.4546	11:11:30	0	19.0132	-0.4557
10:52:00	500	18.8921	-0.4478	10:57:30	500	18.9447	-0.4525	11:02:30	500	18.963	-0.4537	11:07:00	500	18.9717	-0.4547	11:11:30	500	19.0131	-0.4558
10:52:01	0	18.8921	-0.4461	10:57:31	0	18.9445	-0.4523	11:02:31	0	18.9634	-0.4538	11:07:01	0	18.9719	-0.4545	11:11:31	0	19.013	-0.4558
10:52:01	500	18.8922	-0.4472	10:57:31	500	18.9439	-0.4525	11:02:31	500	18.9634	-0.4536	11:07:01	500	18.9718	-0.4547	11:11:31	500	19.0132	-0.4556
10:52:02	0	18.8941	-0.4494	10:57:32	0	18.9444	-0.4525	11:02:32	0	18.9632	-0.4538	11:07:02	0	18.9713	-0.4544	11:11:32	0	19.0133	-0.4555
10:52:02	500	18.8921	-0.4499	10:57:32	500	18.9443	-0.4528	11:02:32	500	18.9632	-0.4536	11:07:02	500	18.9715	-0.4548	11:11:32	500	19.0134	-0.4557
10:52:03	0	18.8917	-0.4498	10:57:33	0	18.9443	-0.4531	11:02:33	0	18.9633	-0.4535	11:07:03	0	18.9713	-0.4546	11:11:33	0	19.0134	-0.4556
10:52:03	500	18.8911	-0.4501	10:57:33	500	18.9442	-0.4528	11:02:33	500	18.9632	-0.4539	11:07:03	500	18.9717	-0.4547	11:11:33	500	19.0135	-0.4556
10:52:04	0	18.8906	-0.4501	10:57:34	0	18.9441	-0.453	11:02:34	0	18.963	-0.4538	11:07:04	0	18.9716	-0.4548	11:11:34	0	19.0132	-0.4558
10:52:04	500	18.8907	-0.4505	10:57:34	500	18.9442	-0.4531	11:02:34	500	18.9633	-0.4539	11:07:04	500	18.9714	-0.4546	11:11:34	500	19.0132	-0.4557
10:52:05	0	18.8906	-0.4503	10:57:35	0	18.9441	-0.4528	11:02:35	0	18.9634	-0.4538	11:07:05	0	18.9714	-0.4546	11:11:35	0	19.013	-0.4559
10:52:05	500	18.8912	-0.4502	10:57:35	500	18.9442	-0.4532	11:02:35	500	18.9634	-0.4535	11:07:05	500	18.9717	-0.4546	11:11:35	500	19.0134	-0.4556

10:52:06	0	18.8917	-0.45	10:57:36	0	18.9441	-0.4527	11:02:36	0	18.9631	-0.4538	11:07:06	0	18.9714	-0.4545	11:11:36	0	19.0132	-0.4558
10:52:06	500	18.8918	-0.4502	10:57:36	500	18.944	-0.4523	11:02:36	500	18.9634	-0.4537	11:07:06	500	18.9717	-0.4545	11:11:36	500	19.013	-0.4556
10:52:07	0	18.8916	-0.4499	10:57:37	0	18.9442	-0.4528	11:02:37	0	18.9633	-0.4535	11:07:07	0	18.9715	-0.4545	11:11:37	0	19.0131	-0.4558
10:52:07	500	18.892	-0.4503	10:57:37	500	18.9448	-0.4531	11:02:37	500	18.9635	-0.4533	11:07:07	500	18.9716	-0.4546	11:11:37	500	19.0133	-0.4559
10:52:08	0	18.8924	-0.4503	10:57:38	0	18.9448	-0.4527	11:02:38	0	18.9634	-0.4517	11:07:08	0	18.9717	-0.4546	11:11:38	0	19.0134	-0.4557
10:52:08	500	18.8924	-0.4503	10:57:38	500	18.945	-0.4525	11:02:38	500	18.963	-0.4492	11:07:08	500	18.9715	-0.4546	11:11:38	500	19.0132	-0.4554
10:52:09	0	18.8922	-0.4503	10:57:39	0	18.9453	-0.4522	11:02:39	0	18.9664	-0.4486	11:07:09	0	18.9715	-0.4545	11:11:39	0	19.0136	-0.4559
10:52:09	500	18.8924	-0.4501	10:57:39	500	18.9451	-0.4524	11:02:39	500	18.9662	-0.449	11:07:09	500	18.9718	-0.4546	11:11:39	500	19.0135	-0.4561
10:52:10	0	18.8931	-0.4503	10:57:40	0	18.9455	-0.4513	11:02:40	0	18.9662	-0.446	11:07:10	0	18.9718	-0.4542	11:11:40	0	19.0132	-0.4558
10:52:10	500	18.8937	-0.4499	10:57:40	500	18.9456	-0.45	11:02:40	500	18.9671	-0.4453	11:07:10	500	18.9717	-0.4547	11:11:40	500	19.0136	-0.4558
10:52:11	0	18.8931	-0.4502	10:57:41	0	18.9492	-0.4502	11:02:41	0	18.9678	-0.4441	11:07:11	0	18.9715	-0.4545	11:11:41	0	19.0131	-0.4557
10:52:11	500	18.8936	-0.4502	10:57:41	500	18.9487	-0.4506	11:02:41	500	18.968	-0.4429	11:07:11	500	18.9712	-0.4546	11:11:41	500	19.0134	-0.4557
10:52:12	0	18.8937	-0.4501	10:57:42	0	18.9488	-0.451	11:02:42	0	18.9682	-0.443	11:07:12	0	18.9716	-0.4547	11:11:42	0	19.0133	-0.456
10:52:12	500	18.8933	-0.45	10:57:42	500	18.949	-0.4516	11:02:42	500	18.968	-0.4442	11:07:12	500	18.9715	-0.4548	11:11:42	500	19.0133	-0.4557
10:52:13	0	18.8934	-0.45	10:57:43	0	18.9484	-0.4517	11:02:43	0	18.9674	-0.4452	11:07:13	0	18.9714	-0.4548	11:11:43	0	19.0133	-0.4556
10:52:13	500	18.894	-0.45	10:57:43	500	18.948	-0.4519	11:02:43	500	18.9662	-0.4443	11:07:13	500	18.9718	-0.4546	11:11:43	500	19.0134	-0.4558

10:52:14	0	18.8944	-0.4505	10:57:44	0	18.9476	-0.452	11:02:44	0	18.9648	-0.4411	11:07:14	0	18.9716	-0.4546	11:11:44	0	19.0135	-0.4555
10:52:14	500	18.8944	-0.4506	10:57:44	500	18.9475	-0.4518	11:02:44	500	18.9657	-0.437	11:07:14	500	18.9715	-0.4542	11:11:44	500	19.0133	-0.4559
10:52:15	0	18.894	-0.4506	10:57:45	0	18.9475	-0.4519	11:02:45	0	18.9664	-0.4336	11:07:15	0	18.9716	-0.4547	11:11:45	0	19.0133	-0.4558
10:52:15	500	18.8941	-0.4498	10:57:45	500	18.9474	-0.4517	11:02:45	500	18.9689	-0.4338	11:07:15	500	18.9731	-0.455	11:11:45	500	19.0135	-0.4557
10:52:16	0	18.894	-0.4486	10:57:46	0	18.9473	-0.4518	11:02:46	0	18.9702	-0.427	11:07:16	0	18.9727	-0.4544	11:11:46	0	19.0131	-0.4558
10:52:16	500	18.8954	-0.4496	10:57:46	500	18.9471	-0.4515	11:02:46	500	18.97	-0.409	11:07:16	500	18.9723	-0.4549	11:11:46	500	19.0133	-0.4559
10:52:17	0	18.8955	-0.4501	10:57:47	0	18.9475	-0.4503	11:02:47	0	18.9761	-0.3923	11:07:17	0	18.9727	-0.4548	11:11:47	0	19.0134	-0.4556
10:52:17	500	18.8951	-0.4502	10:57:47	500	18.9478	-0.4504	11:02:47	500	18.9869	-0.3777	11:07:17	500	18.9725	-0.4546	11:11:47	500	19.0132	-0.4558
10:52:18	0	18.8949	-0.4503	10:57:48	0	18.9482	-0.4507	11:02:48	0	18.9957	-0.3604	11:07:18	0	18.9724	-0.4548	11:11:48	0	19.0133	-0.4557
10:52:18	500	18.8945	-0.4503	10:57:48	500	18.9482	-0.451	11:02:48	500	19.0033	-0.3313	11:07:18	500	18.9728	-0.455	11:11:48	500	19.0133	-0.4557
10:52:19	0	18.8944	-0.4503	10:57:49	0	18.9482	-0.4512	11:02:49	0	19.0161	-0.292	11:07:19	0	18.9725	-0.4545	11:11:49	0	19.0134	-0.4557
10:52:19	500	18.8944	-0.4503	10:57:49	500	18.9478	-0.451	11:02:49	500	19.0342	-0.2721	11:07:19	500	18.9725	-0.4546	11:11:49	500	19.0134	-0.4558
10:52:20	0	18.8945	-0.4503	10:57:50	0	18.948	-0.4504	11:02:50	0	19.0489	-0.2481	11:07:20	0	18.9726	-0.4544	11:11:50	0	19.0133	-0.4559
10:52:20	500	18.8949	-0.45	10:57:50	500	18.9478	-0.4498	11:02:50	500	19.0554	-0.2122	11:07:20	500	18.9728	-0.4451	11:11:50	500	19.0133	-0.4559
10:52:21	0	18.896	-0.4498	10:57:51	0	18.9482	-0.4497	11:02:51	0	19.0709	-0.1896	11:07:21	0	18.9756	-0.4389	11:11:51	0	19.0133	-0.4559
10:52:21	500	18.896	-0.4498	10:57:51	500	18.9486	-0.4503	11:02:51	500	19.0762	-0.1561	11:07:21	500	18.9784	-0.421	11:11:51	500	19.0131	-0.4559

10:52:22	0	18.8963	-0.45	10:57:52	0	18.9485	-0.451	11:02:52	0	19.0858	-0.1379	11:07:22	0	18.9869	-0.4152	11:11:52	0	19.0134	-0.4559
10:52:22	500	18.896	-0.4501	10:57:52	500	18.9484	-0.4514	11:02:52	500	19.0906	-0.1267	11:07:22	500	18.9949	-0.4296	11:11:52	500	19.0135	-0.4556
10:52:23	0	18.8958	-0.4503	10:57:53	0	18.9478	-0.4519	11:02:53	0	19.0868	-0.1246	11:07:23	0	18.9927	-0.4404	11:11:53	0	19.013	-0.456
10:52:23	500	18.8957	-0.4502	10:57:53	500	18.947	-0.4518	11:02:53	500	19.0792	-0.178	11:07:23	500	18.985	-0.4473	11:11:53	500	19.0132	-0.4559
10:52:24	0	18.8961	-0.45	10:57:54	0	18.9469	-0.4518	11:02:54	0	19.0505	-0.2036	11:07:24	0	18.9771	-0.4514	11:11:54	0	19.0132	-0.4562
10:52:24	500	18.8962	-0.4504	10:57:54	500	18.9465	-0.4519	11:02:54	500	19.005	-0.202	11:07:24	500	18.9713	-0.453	11:11:54	500	19.0133	-0.4559
10:52:25	0	18.896	-0.4503	10:57:55	0	18.9469	-0.4513	11:02:55	0	18.976	-0.2298	11:07:25	0	18.9671	-0.4535	11:11:55	0	19.0133	-0.4558
10:52:25	500	18.8964	-0.4503	10:57:55	500	18.9469	-0.4509	11:02:55	500	18.9557	-0.2498	11:07:25	500	18.9642	-0.4535	11:11:55	500	19.0129	-0.4558
10:52:26	0	18.896	-0.4501	10:57:56	0	18.9471	-0.4517	11:02:56	0	18.9266	-0.2578	11:07:26	0	18.9628	-0.453	11:11:56	0	19.0134	-0.4559
10:52:26	500	18.8962	-0.4503	10:57:56	500	18.947	-0.4512	11:02:56	500	18.9064	-0.2704	11:07:26	500	18.9622	-0.4532	11:11:56	500	19.0133	-0.4558
10:52:27	0	18.8961	-0.4499	10:57:57	0	18.9476	-0.4499	11:02:57	0	18.895	-0.28	11:07:27	0	18.9627	-0.4527	11:11:57	0	19.0132	-0.4558
10:52:27	500	18.896	-0.4499	10:57:57	500	18.948	-0.4488	11:02:57	500	18.8861	-0.2946	11:07:27	500	18.9636	-0.4526	11:11:57	500	19.0141	-0.4557
10:52:28	0	18.8963	-0.4506	10:57:58	0	18.9485	-0.4486	11:02:58	0	18.88	-0.3055	11:07:28	0	18.9645	-0.4527	11:11:58	0	19.0142	-0.4555
10:52:28	500	18.8962	-0.4503	10:57:58	500	18.9493	-0.4471	11:02:58	500	18.8774	-0.3154	11:07:28	500	18.9661	-0.453	11:11:58	500	19.014	-0.4548
10:52:29	0	18.896	-0.4503	10:57:59	0	18.9489	-0.4425	11:02:59	0	18.8773	-0.3252	11:07:29	0	18.967	-0.453	11:11:59	0	19.0142	-0.4557
10:52:29	500	18.8961	-0.45	10:57:59	500	18.9513	-0.419	11:02:59	500	18.8807	-0.3181	11:07:29	500	18.9677	-0.4533	11:11:59	500	19.0146	-0.455

10:52:30	0	18.8961	-0.4502	10:58:00	0	18.9582	-0.3742	11:03:00	0	18.8848	-0.3151	11:07:30	0	18.9691	-0.4534	11:12:00	0	19.0146	-0.4548
10:52:30	500	18.8983	-0.3769	10:58:00	500	18.975	-0.3529	11:03:00	500	18.9001	-0.2418	11:07:30	500	18.9701	-0.4289	11:12:00	500	19.0144	-0.4552
10:52:31	0	18.9017	-0.2919	10:58:01	0	18.9976	-0.213	11:03:01	0	18.9184	-0.0504	11:07:31	0	18.9706	-0.2385	11:12:01	0	19.0147	-0.2821
10:52:31	500	18.9595	-0.2278	10:58:01	500	19.035	-0.0794	11:03:01	500	19.0265	0.0996	11:07:31	500	19.0272	-0.1071	11:12:01	500	19.0329	-0.1235
10:52:32	0	19.0068	-0.1791	10:58:02	0	19.1201	0.0423	11:03:02	0	19.1368	0.2091	11:07:32	0	19.1267	0.004	11:12:02	0	19.1522	0.0077
10:52:32	500	19.046	-0.149	10:58:02	500	19.1992	0.1429	11:03:02	500	19.2266	0.3044	11:07:32	500	19.2133	0.0907	11:12:02	500	19.2439	0.1209
10:52:33	0	19.0703	-0.1243	10:58:03	0	19.2635	0.2266	11:03:03	0	19.2993	0.3854	11:07:33	0	19.2775	0.1591	11:12:03	0	19.3244	0.217
10:52:33	500	19.0811	-0.102	10:58:03	500	19.3147	0.2982	11:03:03	500	19.3544	0.45	11:07:33	500	19.3216	0.2136	11:12:03	500	19.3877	0.2985
10:52:34	0	19.0848	-0.0873	10:58:04	0	19.3468	0.3595	11:03:04	0	19.3895	0.4978	11:07:34	0	19.3467	0.2577	11:12:04	0	19.4327	0.3692
10:52:34	500	19.0804	-0.0744	10:58:04	500	19.3625	0.4133	11:03:04	500	19.401	0.5463	11:07:34	500	19.354	0.2957	11:12:04	500	19.4591	0.4332
10:52:35	0	19.068	-0.061	10:58:05	0	19.3618	0.4689	11:03:05	0	19.3931	0.6014	11:07:35	0	19.346	0.3351	11:12:05	0	19.4681	0.4914
10:52:35	500	19.0529	-0.048	10:58:05	500	19.3518	0.5224	11:03:05	500	19.3785	0.6356	11:07:35	500	19.3272	0.3778	11:12:05	500	19.4627	0.5465
10:52:36	0	19.0365	-0.0312	10:58:06	0	19.3353	0.5729	11:03:06	0	19.3549	0.668	11:07:36	0	19.3067	0.415	11:12:06	0	19.4473	0.6004
10:52:36	500	19.0197	-0.0137	10:58:06	500	19.3136	0.6257	11:03:06	500	19.3186	0.7026	11:07:36	500	19.2809	0.4513	11:12:06	500	19.4239	0.6573
10:52:37	0	19.0055	0.0039	10:58:07	0	19.2897	0.6802	11:03:07	0	19.2815	0.7399	11:07:37	0	19.2532	0.4888	11:12:07	0	19.3984	0.7124
10:52:37	500	18.993	0.0215	10:58:07	500	19.267	0.7322	11:03:07	500	19.2455	0.7859	11:07:37	500	19.2268	0.526	11:12:07	500	19.3727	0.7681
10:52:38	0	18.9825	0.0356	10:58:08	0	19.246	0.7835	11:03:08	0	19.2142	0.8234	11:07:38	0	19.2023	0.5616	11:12:08	0	19.3471	0.8251
10:52:38	500	18.9732	0.0553	10:58:08	500	19.2254	0.833	11:03:08	500	19.1916	0.8505	11:07:38	500	19.1798	0.5974	11:12:08	500	19.3241	0.8818
10:52:39	0	18.9649	0.0764	10:58:09	0	19.2074	0.88	11:03:09	0	19.163	0.878	11:07:39	0	19.1598	0.6296	11:12:09	0	19.3042	0.9381

10:52:39	500	18.962	0.0963	10:58:09	500	19.1895	0.9301	11:03:09	500	19.1373	0.9024	11:07:39	500	19.1422	0.6623	11:12:09	500	19.2868	0.9972
10:52:40	0	18.9606	0.1097	10:58:10	0	19.175	0.9801	11:03:10	0	19.1142	0.9297	11:07:40	0	19.1273	0.6944	11:12:10	0	19.2731	1.0566
10:52:40	500	18.959	0.1188	10:58:10	500	19.1639	1.0304	11:03:10	500	19.0942	0.9598	11:07:40	500	19.1155	0.724	11:12:10	500	19.2638	1.115
10:52:41	0	18.9543	0.1281	10:58:11	0	19.1555	1.0853	11:03:11	0	19.0793	1.0401	11:07:41	0	19.1053	0.7515	11:12:11	0	19.2573	1.1716
10:52:41	500	18.9494	0.138	10:58:11	500	19.1518	1.1357	11:03:11	500	19.0748	1.1342	11:07:41	500	19.0958	0.7775	11:12:11	500	19.2518	1.2262
10:52:42	0	18.9449	0.1511	10:58:12	0	19.1497	1.1856	11:03:12	0	19.1109	1.183	11:07:42	0	19.088	0.8001	11:12:12	0	19.2475	1.2803
10:52:42	500	18.9414	0.1596	10:58:12	500	19.1477	1.2346	11:03:12	500	19.1373	1.2162	11:07:42	500	19.0806	0.8203	11:12:12	500	19.244	1.3325
10:52:43	0	18.9399	0.17	10:58:13	0	19.147	1.2829	11:03:13	0	19.1449	1.2436	11:07:43	0	19.0734	0.8387	11:12:13	0	19.2409	1.3818
10:52:43	500	18.9373	0.176	10:58:13	500	19.1465	1.3285	11:03:13	500	19.1443	1.2677	11:07:43	500	19.0658	0.8552	11:12:13	500	19.2374	1.426
10:52:44	0	18.9343	0.1883	10:58:14	0	19.1454	1.3735	11:03:14	0	19.1384	1.2891	11:07:44	0	19.0588	0.8677	11:12:14	0	19.2327	1.4673
10:52:44	500	18.9313	0.2086	10:58:14	500	19.1439	1.4179	11:03:14	500	19.1287	1.3076	11:07:44	500	19.0512	0.8751	11:12:14	500	19.2254	1.5051
10:52:45	0	18.9343	0.219	10:58:15	0	19.1418	1.4603	11:03:15	0	19.1158	1.321	11:07:45	0	19.042	0.8806	11:12:15	0	19.2163	1.5447
10:52:45	500	18.9396	0.2131	10:58:15	500	19.1395	1.5013	11:03:15	500	19.1008	1.3303	11:07:45	500	19.0307	0.8839	11:12:15	500	19.2071	1.5823
10:52:46	0	18.9351	0.2098	10:58:16	0	19.1363	1.5413	11:03:16	0	19.082	1.3393	11:07:46	0	19.0202	0.8925	11:12:16	0	19.1989	1.6148
10:52:46	500	18.9266	0.2111	10:58:16	500	19.1324	1.5802	11:03:16	500	19.0628	1.3516	11:07:46	500	19.0103	0.9015	11:12:16	500	19.1901	1.6324
10:52:47	0	18.9188	0.2507	10:58:17	0	19.1284	1.6166	11:03:17	0	19.0459	1.3616	11:07:47	0	19.005	0.9249	11:12:17	0	19.1773	1.6475
10:52:47	500	18.9221	0.2753	10:58:17	500	19.1234	1.652	11:03:17	500	19.0318	1.3652	11:07:47	500	19.0038	0.947	11:12:17	500	19.158	1.6618
10:52:48	0	18.9378	0.2981	10:58:18	0	19.1176	1.6856	11:03:18	0	19.0172	1.3671	11:07:48	0	19.0102	0.9606	11:12:18	0	19.1386	1.6768
10:52:48	500	18.9484	0.3142	10:58:18	500	19.1118	1.7192	11:03:18	500	19.0027	1.3685	11:07:48	500	19.0155	0.9676	11:12:18	500	19.1206	1.6927
10:52:49	0	18.9572	0.3239	10:58:19	0	19.1057	1.7579	11:03:19	0	18.9889	1.3689	11:07:49	0	19.0171	0.9674	11:12:19	0	19.1052	1.7081
10:52:49	500	18.9612	0.3257	10:58:19	500	19.0991	1.8008	11:03:19	500	18.9776	1.3643	11:07:49	500	19.0141	0.9652	11:12:19	500	19.0919	1.7226
10:52:50	0	18.9597	0.3246	10:58:20	0	19.1005	1.8337	11:03:20	0	18.9668	1.3574	11:07:50	0	19.0078	0.9636	11:12:20	0	19.0812	1.7362
10:52:50	500	18.9531	0.3233	10:58:20	500	19.1	1.8632	11:03:20	500	18.9554	1.3482	11:07:50	500	19.0001	0.9617	11:12:20	500	19.0724	1.7485
10:52:51	0	18.9444	0.3213	10:58:21	0	19.0959	1.8772	11:03:21	0	18.9449	1.3383	11:07:51	0	18.993	0.9597	11:12:21	0	19.0651	1.7621

10:52:51	500	18.9351	0.3196	10:58:21	500	19.09	1.8596	11:03:21	500	18.9346	1.331	11:07:51	500	18.986	0.959	11:12:21	500	19.0593	1.7773
10:52:52	0	18.9256	0.317	10:58:22	0	19.0636	1.8437	11:03:22	0	18.9272	1.3242	11:07:52	0	18.98	0.9575	11:12:22	0	19.0567	1.7902
10:52:52	500	18.9154	0.3158	10:58:22	500	19.0333	1.7978	11:03:22	500	18.9227	1.3163	11:07:52	500	18.975	0.9549	11:12:22	500	19.0552	1.8019
10:52:53	0	18.9068	0.3165	10:58:23	0	18.9927	1.752	11:03:23	0	18.919	1.3131	11:07:53	0	18.9704	0.9524	11:12:23	0	19.0541	1.8124
10:52:53	500	18.8996	0.3177	10:58:23	500	18.9398	1.7188	11:03:23	500	18.9173	1.314	11:07:53	500	18.9659	0.9507	11:12:23	500	19.0535	1.8225
10:52:54	0	18.8954	0.3198	10:58:24	0	18.896	1.6974	11:03:24	0	18.9218	1.3069	11:07:54	0	18.963	0.9486	11:12:24	0	19.0523	1.8296
10:52:54	500	18.8926	0.325	10:58:24	500	18.8629	1.6932	11:03:24	500	18.925	1.2976	11:07:54	500	18.961	0.9469	11:12:24	500	19.0516	1.8335
10:52:55	0	18.8912	0.3314	10:58:25	0	18.8444	1.6984	11:03:25	0	18.9257	1.3367	11:07:55	0	18.9599	0.9456	11:12:25	0	19.048	1.8387
10:52:55	500	18.8939	0.3345	10:58:25	500	18.8411	1.7286	11:03:25	500	18.9301	1.4619	11:07:55	500	18.9598	0.9481	11:12:25	500	19.0455	1.8436
10:52:56	0	18.8965	0.3349	10:58:26	0	18.8507	1.777	11:03:26	0	18.9895	1.5455	11:07:56	0	18.9607	0.9543	11:12:26	0	19.0421	1.8468
10:52:56	500	18.8977	0.3342	10:58:26	500	18.8818	1.8717	11:03:26	500	19.066	1.5967	11:07:56	500	18.965	0.9611	11:12:26	500	19.0393	1.8494
10:52:57	0	18.898	0.3326	10:58:27	0	18.9399	1.9175	11:03:27	0	19.113	1.6036	11:07:57	0	18.9708	0.9657	11:12:27	0	19.036	1.8514
10:52:57	500	18.8975	0.3304	10:58:27	500	18.9997	1.9328	11:03:27	500	19.1448	1.5455	11:07:57	500	18.977	0.9673	11:12:27	500	19.0323	1.8532
10:52:58	0	18.8963	0.3289	10:58:28	0	19.0342	1.9433	11:03:28	0	19.1299	1.475	11:07:58	0	18.981	0.967	11:12:28	0	19.0293	1.855
10:52:58	500	18.8951	0.3265	10:58:28	500	19.051	1.9495	11:03:28	500	19.0794	1.4295	11:07:58	500	18.9832	0.9658	11:12:28	500	19.0264	1.8554
10:52:59	0	18.8938	0.324	10:58:29	0	19.0595	1.9474	11:03:29	0	19.0223	1.3926	11:07:59	0	18.984	0.9628	11:12:29	0	19.0236	1.8536
10:52:59	500	18.8925	0.3218	10:58:29	500	19.059	1.9377	11:03:29	500	18.974	1.3597	11:07:59	500	18.9832	0.9595	11:12:29	500	19.0206	1.8521
10:53:00	0	18.8915	0.318	10:58:30	0	19.0466	1.9217	11:03:30	0	18.9318	1.3405	11:08:00	0	18.9809	0.956	11:12:30	0	19.017	1.8505
10:53:00	500	18.8901	0.3138	10:58:30	500	19.028	1.9044	11:03:30	500	18.8965	1.3242	11:08:00	500	18.9784	0.9534	11:12:30	500	19.0138	1.8501
10:53:01	0	18.8879	0.3096	10:58:31	0	19.0029	1.8937	11:03:31	0	18.8752	1.3138	11:08:01	0	18.9754	0.9498	11:12:31	0	19.0115	1.8504
10:53:01	500	18.886	0.3054	10:58:31	500	18.979	1.8885	11:03:31	500	18.8606	1.3112	11:08:01	500	18.9727	0.9457	11:12:31	500	19.0104	1.8503
10:53:02	0	18.8837	0.303	10:58:32	0	18.9592	1.8846	11:03:32	0	18.8565	1.3069	11:08:02	0	18.9695	0.9433	11:12:32	0	19.0098	1.8489
10:53:02	500	18.8829	0.3005	10:58:32	500	18.9445	1.8844	11:03:32	500	18.8602	1.3043	11:08:02	500	18.9667	0.9409	11:12:32	500	19.0099	1.8468
10:53:03	0	18.8827	0.2986	10:58:33	0	18.9333	1.8876	11:03:33	0	18.8661	1.3059	11:08:03	0	18.9654	0.9372	11:12:33	0	19.0088	1.8389

10:53:03	500	18.8833	0.2958	10:58:33	500	18.9274	1.89	11:03:33	500	18.8787	1.2977	11:08:03	500	18.9639	0.9338	11:12:33	500	19.0068	1.8252
10:53:04	0	18.8836	0.2935	10:58:34	0	18.926	1.8898	11:03:34	0	18.8916	1.2842	11:08:04	0	18.9624	0.9311	11:12:34	0	19.0016	1.8067
10:53:04	500	18.8839	0.2922	10:58:34	500	18.925	1.8877	11:03:34	500	18.8991	1.2713	11:08:04	500	18.9614	0.9282	11:12:34	500	18.9924	1.7931
10:53:05	0	18.8847	0.2902	10:58:35	0	18.9247	1.8869	11:03:35	0	18.905	1.2549	11:08:05	0	18.9612	0.9275	11:12:35	0	18.9824	1.7805
10:53:05	500	18.8862	0.2874	10:58:35	500	18.9256	1.887	11:03:35	500	18.909	1.2392	11:08:05	500	18.9613	0.9266	11:12:35	500	18.9759	1.7693
10:53:06	0	18.8869	0.2842	10:58:36	0	18.9275	1.8866	11:03:36	0	18.9103	1.2237	11:08:06	0	18.9628	0.9256	11:12:36	0	18.9701	1.7588
10:53:06	500	18.887	0.2813	10:58:36	500	18.9304	1.8844	11:03:36	500	18.9113	1.208	11:08:06	500	18.9641	0.9237	11:12:36	500	18.9669	1.749
10:53:07	0	18.887	0.2782	10:58:37	0	18.933	1.8802	11:03:37	0	18.9114	1.1918	11:08:07	0	18.9654	0.9212	11:12:37	0	18.9648	1.7396
10:53:07	500	18.8872	0.2753	10:58:37	500	18.9342	1.874	11:03:37	500	18.9106	1.1765	11:08:07	500	18.9665	0.9185	11:12:37	500	18.964	1.7294
10:53:08	0	18.8873	0.2727	10:58:38	0	18.9339	1.8664	11:03:38	0	18.9091	1.1647	11:08:08	0	18.9666	0.9148	11:12:38	0	18.964	1.7191
10:53:08	500	18.8874	0.2697	10:58:38	500	18.9326	1.8584	11:03:38	500	18.9092	1.1545	11:08:08	500	18.9667	0.9108	11:12:38	500	18.9642	1.709
10:53:09	0	18.8873	0.267	10:58:39	0	18.9307	1.8495	11:03:39	0	18.9107	1.1439	11:08:09	0	18.9661	0.9081	11:12:39	0	18.9656	1.6973
10:53:09	500	18.8872	0.264	10:58:39	500	18.9277	1.8421	11:03:39	500	18.913	1.1339	11:08:09	500	18.9656	0.9056	11:12:39	500	18.9669	1.6841
10:53:10	0	18.8873	0.2612	10:58:40	0	18.9243	1.835	11:03:40	0	18.9143	1.1314	11:08:10	0	18.9653	0.9023	11:12:40	0	18.9666	1.6711
10:53:10	500	18.8872	0.2581	10:58:40	500	18.9229	1.8271	11:03:40	500	18.9185	1.1761	11:08:10	500	18.965	0.9006	11:12:40	500	18.9664	1.659
10:53:11	0	18.887	0.2556	10:58:41	0	18.921	1.8202	11:03:41	0	18.9327	1.2213	11:08:11	0	18.9649	0.9021	11:12:41	0	18.9661	1.6492
10:53:11	500	18.8872	0.2531	10:58:41	500	18.9196	1.8116	11:03:41	500	18.9701	1.3398	11:08:11	500	18.9662	0.9016	11:12:41	500	18.967	1.6393
10:53:12	0	18.8872	0.2505	10:58:42	0	18.9182	1.7995	11:03:42	0	19.0201	1.4462	11:08:12	0	18.9684	0.9007	11:12:42	0	18.9678	1.6293
10:53:12	500	18.8872	0.2476	10:58:42	500	18.9161	1.7849	11:03:42	500	19.1037	1.5194	11:08:12	500	18.9695	0.8983	11:12:42	500	18.97	1.6186
10:53:13	0	18.8872	0.2452	10:58:43	0	18.9119	1.773	11:03:43	0	19.1681	1.567	11:08:13	0	18.9704	0.8954	11:12:43	0	18.9711	1.6077
10:53:13	500	18.8873	0.2433	10:58:43	500	18.9072	1.7623	11:03:43	500	19.2094	1.6044	11:08:13	500	18.9705	0.8919	11:12:43	500	18.9721	1.5978
10:53:14	0	18.8876	0.2414	10:58:44	0	18.905	1.7519	11:03:44	0	19.2325	1.6271	11:08:14	0	18.9698	0.888	11:12:44	0	18.9734	1.5885
10:53:14	500	18.8883	0.2386	10:58:44	500	18.9029	1.7451	11:03:44	500	19.239	1.6358	11:08:14	500	18.9689	0.8855	11:12:44	500	18.9743	1.5797
10:53:15	0	18.8886	0.2351	10:58:45	0	18.9027	1.738	11:03:45	0	19.226	1.6364	11:08:15	0	18.9679	0.8834	11:12:45	0	18.9757	1.5727

10:53:15	500	18.8882	0.2318	10:58:45	500	18.9042	1.7316	11:03:45	500	19.1998	1.633	11:08:15	500	18.9672	0.8815	11:12:45	500	18.9775	1.565
10:53:16	0	18.8877	0.2292	10:58:46	0	18.9067	1.7264	11:03:46	0	19.1641	1.628	11:08:16	0	18.9671	0.88	11:12:46	0	18.9796	1.5551
10:53:16	500	18.8875	0.2265	10:58:46	500	18.9096	1.7217	11:03:46	500	19.1251	1.629	11:08:16	500	18.9673	0.8786	11:12:46	500	18.9813	1.546
10:53:17	0	18.8873	0.2235	10:58:47	0	18.9132	1.7167	11:03:47	0	19.0856	1.6406	11:08:17	0	18.9675	0.877	11:12:47	0	18.9819	1.5369
10:53:17	500	18.8873	0.2208	10:58:47	500	18.9173	1.7108	11:03:47	500	19.0544	1.6541	11:08:17	500	18.9675	0.8752	11:12:47	500	18.9824	1.5289
10:53:18	0	18.8869	0.2181	10:58:48	0	18.9211	1.7017	11:03:48	0	19.0322	1.6662	11:08:18	0	18.968	0.8742	11:12:48	0	18.9827	1.5223
10:53:18	500	18.887	0.2157	10:58:48	500	18.9221	1.6918	11:03:48	500	19.0146	1.6793	11:08:18	500	18.9686	0.8727	11:12:48	500	18.9841	1.5152
10:53:19	0	18.887	0.2134	10:58:49	0	18.9224	1.6819	11:03:49	0	19.0009	1.6771	11:08:19	0	18.969	0.8717	11:12:49	0	18.9853	1.5452
10:53:19	500	18.8876	0.2113	10:58:49	500	18.9209	1.6756	11:03:49	500	18.9893	1.6382	11:08:19	500	18.9695	0.8696	11:12:49	500	18.9868	1.6343
10:53:20	0	18.8876	0.2089	10:58:50	0	18.9207	1.6698	11:03:50	0	18.9672	1.6094	11:08:20	0	18.97	0.8691	11:12:50	0	19.0319	1.7039
10:53:20	500	18.8879	0.2062	10:58:50	500	18.9211	1.666	11:03:50	500	18.9288	1.6914	11:08:20	500	18.9706	0.8699	11:12:50	500	19.0877	1.7333
10:53:21	0	18.8884	0.2042	10:58:51	0	18.9225	1.6647	11:03:51	0	18.9306	1.7132	11:08:21	0	18.9718	0.8709	11:12:51	0	19.1307	1.7568
10:53:21	500	18.8883	0.2019	10:58:51	500	18.926	1.6616	11:03:51	500	18.9724	1.6558	11:08:21	500	18.9733	0.8704	11:12:51	500	19.1499	1.7389
10:53:22	0	18.8889	0.1996	10:58:52	0	18.9286	1.6577	11:03:52	0	18.9571	1.6405	11:08:22	0	18.9742	0.8695	11:12:52	0	19.157	1.7003
10:53:22	500	18.8888	0.1975	10:58:52	500	18.931	1.6541	11:03:52	500	18.93	1.6234	11:08:22	500	18.9749	0.8674	11:12:52	500	19.1298	1.6732
10:53:23	0	18.8893	0.1955	10:58:53	0	18.9326	1.6503	11:03:53	0	18.9257	1.6027	11:08:23	0	18.9751	0.8652	11:12:53	0	19.0967	1.6542
10:53:23	500	18.8893	0.1935	10:58:53	500	18.9344	1.6466	11:03:53	500	18.9084	1.5978	11:08:23	500	18.9744	0.8642	11:12:53	500	19.0641	1.6386
10:53:24	0	18.8893	0.1914	10:58:54	0	18.9356	1.6409	11:03:54	0	18.9038	1.5878	11:08:24	0	18.9736	0.8637	11:12:54	0	19.036	1.6249
10:53:24	500	18.89	0.1902	10:58:54	500	18.9357	1.6364	11:03:54	500	18.9054	1.5803	11:08:24	500	18.9735	0.8641	11:12:54	500	19.0112	1.6158
10:53:25	0	18.89	0.1887	10:58:55	0	18.9351	1.6327	11:03:55	0	18.9021	1.5581	11:08:25	0	18.9737	0.8621	11:12:55	0	18.9906	1.6112
10:53:25	500	18.8909	0.187	10:58:55	500	18.9351	1.6284	11:03:55	500	18.9	1.5306	11:08:25	500	18.9735	0.8532	11:12:55	500	18.9769	1.6118
10:53:26	0	18.8911	0.1846	10:58:56	0	18.9353	1.6232	11:03:56	0	18.8947	1.4955	11:08:26	0	18.9712	0.8465	11:12:56	0	18.9693	1.6221
10:53:26	500	18.8912	0.183	10:58:56	500	18.9351	1.617	11:03:56	500	18.8827	1.4724	11:08:26	500	18.9663	0.8441	11:12:56	500	18.9697	1.6413
10:53:27	0	18.8912	0.1821	10:58:57	0	18.9337	1.6131	11:03:57	0	18.8717	1.451	11:08:27	0	18.9641	0.8408	11:12:57	0	18.9792	1.6645

10:53:27	500	18.8912	0.1977	10:58:57	500	18.9323	1.6098	11:03:57	500	18.8675	1.4267	11:08:27	500	18.9626	0.8367	11:12:57	500	18.9967	1.6755
10:53:28	0	18.8922	0.2459	10:58:58	0	18.9319	1.606	11:03:58	0	18.8638	1.4026	11:08:28	0	18.961	0.8322	11:12:58	0	19.0135	1.6767
10:53:28	500	18.9153	0.269	10:58:58	500	18.9323	1.6031	11:03:58	500	18.8602	1.3745	11:08:28	500	18.9596	0.8274	11:12:58	500	19.0234	1.6703
10:53:29	0	18.9395	0.2875	10:58:59	0	18.9328	1.5991	11:03:59	0	18.857	1.3495	11:08:29	0	18.9582	0.8227	11:12:59	0	19.0275	1.6576
10:53:29	500	18.9547	0.3003	10:58:59	500	18.9331	1.5939	11:03:59	500	18.8526	1.3597	11:08:29	500	18.9574	0.8182	11:12:59	500	19.0253	1.6452
10:53:30	0	18.965	0.3088	10:59:00	0	18.9331	1.5891	11:04:00	0	18.8549	1.4205	11:08:30	0	18.9564	0.814	11:13:00	0	19.0188	1.6345
10:53:30	500	18.9705	0.3099	10:59:00	500	18.9327	1.5857	11:04:00	500	18.8944	1.4634	11:08:30	500	18.9562	0.8089	11:13:00	500	19.0116	1.6253
10:53:31	0	18.9702	0.3093	10:59:01	0	18.9321	1.5831	11:04:01	0	18.9433	1.4855	11:08:31	0	18.9558	0.8041	11:13:01	0	19.0044	1.6178
10:53:31	500	18.9641	0.309	10:59:01	500	18.933	1.5831	11:04:01	500	18.9838	1.4954	11:08:31	500	18.9552	0.8015	11:13:01	500	18.9986	1.6119
10:53:32	0	18.9559	0.3054	10:59:02	0	18.9346	1.5809	11:04:02	0	19.0075	1.4944	11:08:32	0	18.9553	0.8129	11:13:02	0	18.9939	1.6076
10:53:32	500	18.9453	0.3012	10:59:02	500	18.9366	1.5762	11:04:02	500	19.0246	1.4891	11:08:32	500	18.9572	0.8305	11:13:02	500	18.9909	1.6052
10:53:33	0	18.9337	0.2993	10:59:03	0	18.9378	1.563	11:04:03	0	19.0279	1.4818	11:08:33	0	18.9723	0.8332	11:13:03	0	18.9901	1.6022
10:53:33	500	18.9219	0.2992	10:59:03	500	18.9339	1.5582	11:04:03	500	19.0253	1.4717	11:08:33	500	18.9822	0.8307	11:13:03	500	18.9908	1.5978
10:53:34	0	18.9127	0.2957	10:59:04	0	18.9305	1.5535	11:04:04	0	19.0171	1.4751	11:08:34	0	18.9856	0.827	11:13:04	0	18.9914	1.5939
10:53:34	500	18.9052	0.2876	10:59:04	500	18.9303	1.5483	11:04:04	500	19.0084	1.4773	11:08:34	500	18.9863	0.8223	11:13:04	500	18.9923	1.5902
10:53:35	0	18.8952	0.2838	10:59:05	0	18.9287	1.5461	11:04:05	0	19.0043	1.4741	11:08:35	0	18.9851	0.8178	11:13:05	0	18.9931	1.5865
10:53:35	500	18.8862	0.2818	10:59:05	500	18.9284	1.546	11:04:05	500	18.9956	1.4726	11:08:35	500	18.9825	0.8136	11:13:05	500	18.9945	1.5823
10:53:36	0	18.8811	0.2815	10:59:06	0	18.9299	1.5478	11:04:06	0	18.9872	1.47	11:08:36	0	18.9794	0.8096	11:13:06	0	18.9957	1.5778
10:53:36	500	18.8782	0.2819	10:59:06	500	18.9338	1.5467	11:04:06	500	18.9792	1.4762	11:08:36	500	18.9755	0.8069	11:13:06	500	18.997	1.5714
10:53:37	0	18.8778	0.2819	10:59:07	0	18.9373	1.5434	11:04:07	0	18.9736	1.4791	11:08:37	0	18.9728	0.8026	11:13:07	0	18.997	1.5659
10:53:37	500	18.8778	0.2806	10:59:07	500	18.9386	1.5421	11:04:07	500	18.9716	1.4838	11:08:37	500	18.9696	0.7976	11:13:07	500	18.9968	1.5598
10:53:38	0	18.8796	0.2797	10:59:08	0	18.9403	1.5399	11:04:08	0	18.9698	1.4879	11:08:38	0	18.9662	0.792	11:13:08	0	18.9967	1.5548
10:53:38	500	18.8809	0.2781	10:59:08	500	18.9413	1.5377	11:04:08	500	18.9695	1.4879	11:08:38	500	18.963	0.7883	11:13:08	500	18.9961	1.55
10:53:39	0	18.8825	0.2777	10:59:09	0	18.9425	1.5356	11:04:09	0	18.969	1.4885	11:08:39	0	18.96	0.7846	11:13:09	0	18.996	1.5443

10:53:39	500	18.8845	0.278	10:59:09	500	18.9425	1.539	11:04:09	500	18.967	1.488	11:08:39	500	18.9585	0.7808	11:13:09	500	18.9959	1.5403
10:53:40	0	18.8869	0.2783	10:59:10	0	18.9438	1.544	11:04:10	0	18.9664	1.4742	11:08:40	0	18.9575	0.7749	11:13:10	0	18.9959	1.537
10:53:40	500	18.8902	0.2774	10:59:10	500	18.9488	1.5477	11:04:10	500	18.9615	1.4583	11:08:40	500	18.9564	0.7685	11:13:10	500	18.9966	1.5334
10:53:41	0	18.8927	0.2753	10:59:11	0	18.9526	1.5524	11:04:11	0	18.9516	1.4401	11:08:41	0	18.9542	0.7624	11:13:11	0	18.9977	1.5293
10:53:41	500	18.8939	0.2735	10:59:11	500	18.9562	1.5446	11:04:11	500	18.939	1.4383	11:08:41	500	18.9526	0.7582	11:13:11	500	18.9984	1.5245
10:53:42	0	18.8944	0.2725	10:59:12	0	18.9581	1.5346	11:04:12	0	18.9324	1.4265	11:08:42	0	18.9518	0.7549	11:13:12	0	18.9989	1.5203
10:53:42	500	18.8951	0.2712	10:59:12	500	18.952	1.528	11:04:12	500	18.9303	1.3917	11:08:42	500	18.9523	0.7514	11:13:12	500	18.9994	1.5169
10:53:43	0	18.8961	0.2683	10:59:13	0	18.9476	1.5278	11:04:13	0	18.9208	1.3711	11:08:43	0	18.9532	0.7488	11:13:13	0	18.9997	1.5115
10:53:43	500	18.8956	0.2659	10:59:13	500	18.942	1.5264	11:04:13	500	18.901	1.4556	11:08:43	500	18.9544	0.7464	11:13:13	500	19.0003	1.5052
10:53:44	0	18.895	0.2628	10:59:14	0	18.943	1.525	11:04:14	0	18.9008	1.5589	11:08:44	0	18.9563	0.7433	11:13:14	0	18.9988	1.4988
10:53:44	500	18.8941	0.259	10:59:14	500	18.9401	1.5248	11:04:14	500	18.984	1.6019	11:08:44	500	18.9583	0.7406	11:13:14	500	18.9981	1.494
10:53:45	0	18.8926	0.2558	10:59:15	0	18.9399	1.5319	11:04:15	0	19.0356	1.6206	11:08:45	0	18.96	0.7352	11:13:15	0	18.9968	1.4901
10:53:45	500	18.8909	0.2533	10:59:15	500	18.9425	1.5329	11:04:15	500	19.069	1.5968	11:08:45	500	18.9611	0.7289	11:13:15	500	18.9967	1.4876
10:53:46	0	18.8899	0.2525	10:59:16	0	18.9453	1.5311	11:04:16	0	19.0759	1.5577	11:08:46	0	18.9604	0.7239	11:13:16	0	18.9969	1.4843
10:53:46	500	18.8895	0.2515	10:59:16	500	18.9475	1.5229	11:04:16	500	19.0559	1.5135	11:08:46	500	18.9597	0.7191	11:13:16	500	18.9985	1.4808
10:53:47	0	18.8898	0.2507	10:59:17	0	18.9464	1.5188	11:04:17	0	19.0232	1.4766	11:08:47	0	18.9595	0.7153	11:13:17	0	18.9993	1.4779
10:53:47	500	18.8903	0.2497	10:59:17	500	18.9422	1.5168	11:04:17	500	18.9859	1.4448	11:08:47	500	18.9593	0.7134	11:13:17	500	19.0004	1.4756
10:53:48	0	18.891	0.2488	10:59:18	0	18.9408	1.5234	11:04:18	0	18.9508	1.4169	11:08:48	0	18.9598	0.7154	11:13:18	0	19.0011	1.4725
10:53:48	500	18.8918	0.2472	10:59:18	500	18.9411	1.5732	11:04:18	500	18.9197	1.3938	11:08:48	500	18.962	0.716	11:13:18	500	19.0026	1.4696
10:53:49	0	18.8922	0.2455	10:59:19	0	18.9557	1.6153	11:04:19	0	18.8948	1.3747	11:08:49	0	18.9653	0.7128	11:13:19	0	19.0033	1.4663
10:53:49	500	18.8926	0.2437	10:59:19	500	18.987	1.6438	11:04:19	500	18.8765	1.3579	11:08:49	500	18.9675	0.707	11:13:19	500	19.004	1.4631
10:53:50	0	18.8928	0.2421	10:59:20	0	19.0117	1.6625	11:04:20	0	18.8643	1.3452	11:08:50	0	18.9672	0.7017	11:13:20	0	19.0048	1.46
10:53:50	500	18.8929	0.2404	10:59:20	500	19.0282	1.6784	11:04:20	500	18.858	1.3434	11:08:50	500	18.9663	0.7329	11:13:20	500	19.0046	1.4569
10:53:51	0	18.8926	0.2389	10:59:21	0	19.0378	1.6917	11:04:21	0	18.8575	1.3519	11:08:51	0	18.9679	0.7517	11:13:21	0	19.0051	1.4541

10:53:51	500	18.8926	0.2368	10:59:21	500	19.0429	1.7009	11:04:21	500	18.8726	1.3912	11:08:51	500	18.9912	0.7563	11:13:21	500	19.0052	1.4513
10:53:52	0	18.8926	0.2357	10:59:22	0	19.0431	1.7048	11:04:22	0	18.8962	1.4116	11:08:52	0	19.0011	0.7575	11:13:22	0	19.0056	1.4486
10:53:52	500	18.8926	0.2339	10:59:22	500	19.0386	1.7062	11:04:22	500	18.9317	1.3989	11:08:52	500	19.0049	0.7549	11:13:22	500	19.0054	1.4459
10:53:53	0	18.8927	0.2324	10:59:23	0	19.0282	1.706	11:04:23	0	18.9504	1.4023	11:08:53	0	19.0049	0.7527	11:13:23	0	19.0053	1.443
10:53:53	500	18.8931	0.2312	10:59:23	500	19.0159	1.7049	11:04:23	500	18.9593	1.3943	11:08:53	500	19.0027	0.7496	11:13:23	500	19.0057	1.4401
10:53:54	0	18.8931	0.2299	10:59:24	0	19.0021	1.7058	11:04:24	0	18.97	1.3762	11:08:54	0	18.999	0.7463	11:13:24	0	19.0055	1.4376
10:53:54	500	18.8931	0.2289	10:59:24	500	18.9891	1.7061	11:04:24	500	18.9696	1.3519	11:08:54	500	18.9934	0.7433	11:13:24	500	19.0056	1.4356
10:53:55	0	18.8931	0.2277	10:59:25	0	18.9776	1.706	11:04:25	0	18.9612	1.3341	11:08:55	0	18.9878	0.739	11:13:25	0	19.0057	1.4339
10:53:55	500	18.8935	0.2271	10:59:25	500	18.9666	1.7061	11:04:25	500	18.9499	1.3232	11:08:55	500	18.982	0.7351	11:13:25	500	19.0066	1.4325
10:53:56	0	18.894	0.2259	10:59:26	0	18.9576	1.7077	11:04:26	0	18.941	1.3153	11:08:56	0	18.9763	0.7338	11:13:26	0	19.0069	1.4305
10:53:56	500	18.894	0.2245	10:59:26	500	18.9507	1.7103	11:04:26	500	18.9364	1.308	11:08:56	500	18.9714	0.7324	11:13:26	500	19.0076	1.4282
10:53:57	0	18.8944	0.2232	10:59:27	0	18.9462	1.7142	11:04:27	0	18.9331	1.2974	11:08:57	0	18.9688	0.7301	11:13:27	0	19.008	1.4261
10:53:57	500	18.8944	0.2219	10:59:27	500	18.9442	1.7195	11:04:27	500	18.93	1.2874	11:08:57	500	18.9661	0.7299	11:13:27	500	19.008	1.4235
10:53:58	0	18.8946	0.2185	10:59:28	0	18.9438	1.723	11:04:28	0	18.926	1.2783	11:08:58	0	18.9645	0.7278	11:13:28	0	19.0079	1.4209
10:53:58	500	18.8942	0.2142	10:59:28	500	18.9455	1.7251	11:04:28	500	18.9241	1.2722	11:08:58	500	18.9638	0.7262	11:13:28	500	19.008	1.4188
10:53:59	0	18.8925	0.2117	10:59:29	0	18.9468	1.7259	11:04:29	0	18.9231	1.2686	11:08:59	0	18.9632	0.7259	11:13:29	0	19.0078	1.4172
10:53:59	500	18.891	0.21	10:59:29	500	18.9475	1.7277	11:04:29	500	18.9242	1.2661	11:08:59	500	18.9634	0.7256	11:13:29	500	19.0081	1.4144
10:54:00	0	18.8898	0.2094	10:59:30	0	18.9484	1.7314	11:04:30	0	18.9281	1.2668	11:09:00	0	18.9644	0.7255	11:13:30	0	19.0083	1.4114
10:54:00	500	18.8911	0.2066	10:59:30	500	18.9497	1.7356	11:04:30	500	18.9329	1.2652	11:09:00	500	18.9656	0.7254	11:13:30	500	19.0072	1.4092
10:54:01	0	18.8907	0.2032	10:59:31	0	18.9527	1.7388	11:04:31	0	18.9393	1.2594	11:09:01	0	18.9675	0.7241	11:13:31	0	19.0071	1.4082
10:54:01	500	18.8897	0.199	10:59:31	500	18.9551	1.7406	11:04:31	500	18.9429	1.2539	11:09:01	500	18.9693	0.7213	11:13:31	500	19.0076	1.4059
10:54:02	0	18.8883	0.1958	10:59:32	0	18.9564	1.7418	11:04:32	0	18.9451	1.2634	11:09:02	0	18.9696	0.7188	11:13:32	0	19.0078	1.4059
10:54:02	500	18.8875	0.1917	10:59:32	500	18.9578	1.7402	11:04:32	500	18.9486	1.2822	11:09:02	500	18.9698	0.7164	11:13:32	500	19.0081	1.4068
10:54:03	0	18.8868	0.1878	10:59:33	0	18.9572	1.7382	11:04:33	0	18.9638	1.2695	11:09:03	0	18.9693	0.7137	11:13:33	0	19.0098	1.4072

10:54:03	500	18.8856	0.1859	10:59:33	500	18.9553	1.7379	11:04:33	500	18.971	1.2638	11:09:03	500	18.9694	0.712	11:13:33	500	19.0114	1.4065
10:54:04	0	18.8849	0.184	10:59:34	0	18.9532	1.7399	11:04:34	0	18.9678	1.2563	11:09:04	0	18.9688	0.7106	11:13:34	0	19.0126	1.407
10:54:04	500	18.8854	0.1814	10:59:34	500	18.9528	1.7395	11:04:34	500	18.9669	1.2509	11:09:04	500	18.9686	0.709	11:13:34	500	19.0139	1.4078
10:54:05	0	18.8859	0.1792	10:59:35	0	18.9528	1.7398	11:04:35	0	18.9634	1.2448	11:09:05	0	18.9689	0.7069	11:13:35	0	19.0154	1.4085
10:54:05	500	18.8863	0.1761	10:59:35	500	18.9506	1.7446	11:04:35	500	18.9599	1.2515	11:09:05	500	18.9689	0.7046	11:13:35	500	19.0168	1.4088
10:54:06	0	18.8867	0.1729	10:59:36	0	18.9515	1.7497	11:04:36	0	18.9586	1.2649	11:09:06	0	18.9688	0.7038	11:13:36	0	19.0178	1.409
10:54:06	500	18.8873	0.169	10:59:36	500	18.954	1.7538	11:04:36	500	18.9657	1.266	11:09:06	500	18.9684	0.7047	11:13:36	500	19.0187	1.4081
10:54:07	0	18.8865	0.1657	10:59:37	0	18.9564	1.7553	11:04:37	0	18.9706	1.265	11:09:07	0	18.9692	0.7066	11:13:37	0	19.0187	1.4076
10:54:07	500	18.8862	0.1628	10:59:37	500	18.9576	1.7588	11:04:37	500	18.9723	1.2628	11:09:07	500	18.9718	0.7061	11:13:37	500	19.0183	1.4065
10:54:08	0	18.8862	0.1599	10:59:38	0	18.9583	1.7608	11:04:38	0	18.972	1.2625	11:09:08	0	18.973	0.7052	11:13:38	0	19.0177	1.4058
10:54:08	500	18.8866	0.1565	10:59:38	500	18.9596	1.7624	11:04:38	500	18.97	1.2663	11:09:08	500	18.9736	0.7037	11:13:38	500	19.0169	1.4049
10:54:09	0	18.8864	0.1538	10:59:39	0	18.9599	1.765	11:04:39	0	18.9713	1.2663	11:09:09	0	18.9742	0.7019	11:13:39	0	19.0165	1.4033
10:54:09	500	18.8866	0.151	10:59:39	500	18.9597	1.7656	11:04:39	500	18.9724	1.2672	11:09:09	500	18.9742	0.7005	11:13:39	500	19.0153	1.4018
10:54:10	0	18.8866	0.1483	10:59:40	0	18.9598	1.7646	11:04:40	0	18.9702	1.3121	11:09:10	0	18.9739	0.6983	11:13:40	0	19.014	1.401
10:54:10	500	18.8868	0.1458	10:59:40	500	18.9587	1.7644	11:04:40	500	18.9823	1.3327	11:09:10	500	18.9727	0.6968	11:13:40	500	19.0132	1.3999
10:54:11	0	18.8872	0.143	10:59:41	0	18.956	1.764	11:04:41	0	19.002	1.3459	11:09:11	0	18.972	0.6946	11:13:41	0	19.0127	1.3989
10:54:11	500	18.8876	0.1407	10:59:41	500	18.9546	1.7636	11:04:41	500	19.0122	1.3582	11:09:11	500	18.9713	0.6924	11:13:41	500	19.0121	1.3985
10:54:12	0	18.8877	0.1382	10:59:42	0	18.9527	1.7631	11:04:42	0	19.0213	1.3314	11:09:12	0	18.9705	0.6908	11:13:42	0	19.0121	1.398
10:54:12	500	18.888	0.136	10:59:42	500	18.9508	1.7628	11:04:42	500	19.0168	1.3031	11:09:12	500	18.9696	0.6885	11:13:42	500	19.0119	1.3977
10:54:13	0	18.8886	0.1331	10:59:43	0	18.9494	1.7629	11:04:43	0	18.9937	1.2802	11:09:13	0	18.969	0.6896	11:13:43	0	19.0121	1.3978
10:54:13	500	18.8885	0.1308	10:59:43	500	18.9479	1.7655	11:04:43	500	18.9717	1.2659	11:09:13	500	18.9686	0.6937	11:13:43	500	19.0125	1.3979
10:54:14	0	18.8886	0.1281	10:59:44	0	18.9481	1.769	11:04:44	0	18.9515	1.2607	11:09:14	0	18.9703	0.716	11:13:44	0	19.0131	1.3978
10:54:14	500	18.8894	0.1247	10:59:44	500	18.9495	1.7699	11:04:44	500	18.9384	1.2584	11:09:14	500	18.9798	0.7216	11:13:44	500	19.0139	1.3978
10:54:15	0	18.8894	0.1226	10:59:45	0	18.9507	1.7695	11:04:45	0	18.931	1.2584	11:09:15	0	18.9903	0.7153	11:13:45	0	19.0143	1.3974

10:54:15	500	18.8892	0.1222	10:59:45	500	18.9507	1.7713	11:04:45	500	18.9278	1.2603	11:09:15	500	18.9915	0.7083	11:13:45	500	19.0145	1.3966
10:54:16	0	18.8898	0.1212	10:59:46	0	18.9512	1.7723	11:04:46	0	18.9287	1.2641	11:09:16	0	18.9883	0.7043	11:13:46	0	19.0149	1.3947
10:54:16	500	18.8908	0.1187	10:59:46	500	18.9522	1.7713	11:04:46	500	18.9322	1.2613	11:09:16	500	18.9836	0.7018	11:13:46	500	19.0148	1.3925
10:54:17	0	18.8918	0.116	10:59:47	0	18.9524	1.7729	11:04:47	0	18.9372	1.2511	11:09:17	0	18.9802	0.7065	11:13:47	0	19.014	1.3919
10:54:17	500	18.8915	0.1194	10:59:47	500	18.9521	1.7667	11:04:47	500	18.9371	1.2426	11:09:17	500	18.9789	0.7132	11:13:47	500	19.0132	1.3914
10:54:18	0	18.8919	0.1292	10:59:48	0	18.9507	1.7576	11:04:48	0	18.9357	1.2363	11:09:18	0	18.9811	0.7172	11:13:48	0	19.0128	1.391
10:54:18	500	18.8977	0.1337	10:59:48	500	18.9452	1.7481	11:04:48	500	18.9356	1.2284	11:09:18	500	18.9832	0.7198	11:13:48	500	19.0136	1.3904
10:54:19	0	18.904	0.1333	10:59:49	0	18.9393	1.7383	11:04:49	0	18.9356	1.2212	11:09:19	0	18.9844	0.7216	11:13:49	0	19.0133	1.3893
10:54:19	500	18.9065	0.1328	10:59:49	500	18.9333	1.733	11:04:49	500	18.935	1.2143	11:09:19	500	18.9852	0.7227	11:13:49	500	19.013	1.3882
10:54:20	0	18.9075	0.131	10:59:50	0	18.9278	1.7275	11:04:50	0	18.9348	1.2083	11:09:20	0	18.9855	0.7229	11:13:50	0	19.0127	1.3874
10:54:20	500	18.9075	0.1302	10:59:50	500	18.9247	1.7274	11:04:50	500	18.9352	1.2037	11:09:20	500	18.9847	0.7228	11:13:50	500	19.0129	1.3858
10:54:21	0	18.9068	0.1292	10:59:51	0	18.9226	1.7251	11:04:51	0	18.9361	1.2061	11:09:21	0	18.9835	0.7237	11:13:51	0	19.0128	1.385
10:54:21	500	18.9053	0.1281	10:59:51	500	18.9252	1.7211	11:04:51	500	18.9392	1.2019	11:09:21	500	18.9824	0.725	11:13:51	500	19.0121	1.3851
10:54:22	0	18.9041	0.1275	10:59:52	0	18.9255	1.7173	11:04:52	0	18.9439	1.1975	11:09:22	0	18.9819	0.7263	11:13:52	0	19.0123	1.3845
10:54:22	500	18.9022	0.1274	10:59:52	500	18.9263	1.7138	11:04:52	500	18.9457	1.197	11:09:22	500	18.9813	0.7273	11:13:52	500	19.0128	1.4244
10:54:23	0	18.9011	0.127	10:59:53	0	18.9272	1.71	11:04:53	0	18.9477	1.2015	11:09:23	0	18.9806	0.7287	11:13:53	0	19.0136	1.5113
10:54:23	500	18.9004	0.1266	10:59:53	500	18.9289	1.7036	11:04:53	500	18.9528	1.2067	11:09:23	500	18.9802	0.7305	11:13:53	500	19.0572	1.5735
10:54:24	0	18.8992	0.1267	10:59:54	0	18.9298	1.6975	11:04:54	0	18.9593	1.2111	11:09:24	0	18.9802	0.7312	11:13:54	0	19.1061	1.617
10:54:24	500	18.8987	0.1261	10:59:54	500	18.9285	1.6838	11:04:54	500	18.9658	1.2134	11:09:24	500	18.9802	0.7323	11:13:54	500	19.1425	1.6471
10:54:25	0	18.8979	0.1248	10:59:55	0	18.927	1.6709	11:04:55	0	18.9706	1.2141	11:09:25	0	18.9803	0.7318	11:13:55	0	19.1672	1.6631
10:54:25	500	18.8974	0.1228	10:59:55	500	18.9208	1.662	11:04:55	500	18.9739	1.2161	11:09:25	500	18.9794	0.7309	11:13:55	500	19.1777	1.6713
10:54:26	0	18.8966	0.1207	10:59:56	0	18.9172	1.6554	11:04:56	0	18.9759	1.2158	11:09:26	0	18.9786	0.7293	11:13:56	0	19.1752	1.6759
10:54:26	500	18.8951	0.119	10:59:56	500	18.9154	1.6499	11:04:56	500	18.977	1.2178	11:09:26	500	18.9771	0.7285	11:13:56	500	19.1644	1.6776
10:54:27	0	18.8938	0.1175	10:59:57	0	18.9151	1.642	11:04:57	0	18.9769	1.2229	11:09:27	0	18.9752	0.7277	11:13:57	0	19.1476	1.6782

10:54:27	500	18.8931	0.1157	10:59:57	500	18.9152	1.633	11:04:57	500	18.9791	1.2263	11:09:27	500	18.9744	0.7262	11:13:57	500	19.1275	1.6805
10:54:28	0	18.8922	0.1139	10:59:58	0	18.9153	1.6865	11:04:58	0	18.9794	1.2439	11:09:28	0	18.9736	0.7492	11:13:58	0	19.1058	1.6838
10:54:28	500	18.8917	0.1123	10:59:58	500	18.9176	1.7629	11:04:58	500	18.9858	1.256	11:09:28	500	18.9727	0.7991	11:13:58	500	19.086	1.6881
10:54:29	0	18.8914	0.1107	10:59:59	0	18.9711	1.825	11:04:59	0	18.992	1.2523	11:09:29	0	18.9983	0.8335	11:13:59	0	19.0681	1.6943
10:54:29	500	18.8911	0.1094	10:59:59	500	19.0206	1.8706	11:04:59	500	18.995	1.2416	11:09:29	500	19.0247	0.8564	11:13:59	500	19.0534	1.7015
10:54:30	0	18.8912	0.1079	11:00:00	0	19.0632	1.8984	11:05:00	0	18.9884	1.2404	11:09:30	0	19.044	0.8728	11:14:00	0	19.0426	1.7098
10:54:30	500	18.8916	0.1062	11:00:00	500	19.0895	1.9276	11:05:00	500	18.979	-0.0275	11:09:30	500	19.0568	0.8815	11:14:00	500	19.0349	1.7192
10:54:31	0	18.8917	-0.3879	11:00:01	0	19.1058	-0.5672	11:05:01	0	18.9785	-0.5413	11:09:31	0	19.063	-0.4849	11:14:01	0	19.0303	-0.2993
10:54:31	500	18.8818	-0.4628	11:00:01	500	18.8557	-0.4383	11:05:01	500	17.9188	-0.4306	11:09:31	500	18.087	-0.4511	11:14:01	500	19.0279	-0.4827
10:54:32	0	18.7232	-0.4482	11:00:02	0	17.7128	-0.449	11:05:02	0	17.4085	-0.4633	11:09:32	0	18.5735	-0.4628	11:14:02	0	18.4069	-0.4642
10:54:32	500	18.6794	-0.4462	11:00:02	500	17.7209	-0.4604	11:05:02	500	17.8364	-0.4517	11:09:32	500	18.1826	-0.4529	11:14:02	500	17.4662	-0.4474
10:54:33	0	18.4646	-0.4562	11:00:03	0	17.4242	-0.447	11:05:03	0	17.7235	-0.4562	11:09:33	0	18.2895	-0.4549	11:14:03	0	17.5258	-0.4629
10:54:33	500	18.5958	-0.4485	11:00:03	500	17.513	-0.4564	11:05:03	500	17.9454	-0.4524	11:09:33	500	18.2153	-0.4568	11:14:03	500	17.599	-0.4518
10:54:34	0	18.5846	-0.452	11:00:04	0	17.6714	-0.451	11:05:04	0	18.0123	-0.4557	11:09:34	0	18.3383	-0.4533	11:14:04	0	17.688	-0.4584
10:54:34	500	18.6363	-0.4518	11:00:04	500	17.8226	-0.454	11:05:04	500	18.1937	-0.453	11:09:34	500	18.3846	-0.4559	11:14:04	500	17.9047	-0.4546
10:54:35	0	18.699	-0.4511	11:00:05	0	18.0226	-0.4525	11:05:05	0	18.3113	-0.4549	11:09:35	0	18.5083	-0.4545	11:14:05	0	18.0658	-0.4564
10:54:35	500	18.7329	-0.4514	11:00:05	500	18.1934	-0.4529	11:05:05	500	18.4577	-0.4539	11:09:35	500	18.5974	-0.4554	11:14:05	500	18.2543	-0.456
10:54:36	0	18.78	-0.4515	11:00:06	0	18.3546	-0.453	11:05:06	0	18.5757	-0.4537	11:09:36	0	18.6929	-0.4557	11:14:06	0	18.4098	-0.4559

10:54:36	500	18.8221	-0.4512	11:00:06	500	18.4969	-0.4529	11:05:06	500	18.6802	-0.4543	11:09:36	500	18.7813	-0.455	11:14:06	500	18.5508	-0.4558
10:54:37	0	18.8547	-0.4514	11:00:07	0	18.6153	-0.4526	11:05:07	0	18.7728	-0.454	11:09:37	0	18.8527	-0.4553	11:14:07	0	18.6746	-0.4557
10:54:37	500	18.8847	-0.4513	11:00:07	500	18.7185	-0.452	11:05:07	500	18.8471	-0.454	11:09:37	500	18.9151	-0.4553	11:14:07	500	18.7775	-0.4556
10:54:38	0	18.9089	-0.4515	11:00:08	0	18.8041	-0.4521	11:05:08	0	18.9075	-0.4542	11:09:38	0	18.9665	-0.4552	11:14:08	0	18.8634	-0.4559
10:54:38	500	18.9273	-0.4514	11:00:08	500	18.8701	-0.4521	11:05:08	500	18.9573	-0.454	11:09:38	500	19.0059	-0.4554	11:14:08	500	18.9311	-0.456
10:54:39	0	18.9408	-0.4513	11:00:09	0	18.9213	-0.4525	11:05:09	0	18.9924	-0.4539	11:09:39	0	19.0361	-0.4552	11:14:09	0	18.9834	-0.4562
10:54:39	500	18.9508	-0.4518	11:00:09	500	18.9621	-0.4527	11:05:09	500	19.0174	-0.4541	11:09:39	500	19.0577	-0.4553	11:14:09	500	19.0263	-0.4558
10:54:40	0	18.957	-0.4514	11:00:10	0	18.994	-0.4521	11:05:10	0	19.0341	-0.4539	11:09:40	0	19.072	-0.4554	11:14:10	0	19.057	-0.4561
10:54:40	500	18.9576	-0.4518	11:00:10	500	19.0134	-0.4521	11:05:10	500	19.0437	-0.4542	11:09:40	500	19.08	-0.455	11:14:10	500	19.0782	-0.456
10:54:41	0	18.9597	-0.4518	11:00:11	0	19.0232	-0.4519	11:05:11	0	19.0473	-0.4539	11:09:41	0	19.0834	-0.4551	11:14:11	0	19.0905	-0.4558
10:54:41	500	18.9579	-0.4512	11:00:11	500	19.0296	-0.4525	11:05:11	500	19.0461	-0.4539	11:09:41	500	19.082	-0.4552	11:14:11	500	19.0964	-0.456
10:54:42	0	18.9531	-0.4513	11:00:12	0	19.0305	-0.453	11:05:12	0	19.041	-0.454	11:09:42	0	19.077	-0.4551	11:14:12	0	19.0966	-0.4557
10:54:42	500	18.9491	-0.4516	11:00:12	500	19.0251	-0.453	11:05:12	500	19.0335	-0.454	11:09:42	500	19.0709	-0.4552	11:14:12	500	19.0926	-0.4556
10:54:43	0	18.9441	-0.451	11:00:13	0	19.0184	-0.4529	11:05:13	0	19.0242	-0.454	11:09:43	0	19.0638	-0.4551	11:14:13	0	19.0856	-0.4558
10:54:43	500	18.9384	-0.4511	11:00:13	500	19.0087	-0.4519	11:05:13	500	19.0142	-0.4542	11:09:43	500	19.0554	-0.4551	11:14:13	500	19.0771	-0.456
10:54:44	0	18.934	-0.4516	11:00:14	0	18.9965	-0.4527	11:05:14	0	19.0042	-0.454	11:09:44	0	19.0467	-0.4555	11:14:14	0	19.0674	-0.4565

10:54:44	500	18.9312	-0.4513	11:00:14	500	18.9914	-0.4526	11:05:14	500	18.9947	-0.4539	11:09:44	500	19.038	-0.4553	11:14:14	500	19.058	-0.4561
10:54:45	0	18.9256	-0.4514	11:00:15	0	18.9795	-0.4519	11:05:15	0	18.9862	-0.4539	11:09:45	0	19.0306	-0.4553	11:14:15	0	19.0488	-0.456
10:54:45	500	18.9213	-0.4515	11:00:15	500	18.9705	-0.452	11:05:15	500	18.9784	-0.4538	11:09:45	500	19.0245	-0.4552	11:14:15	500	19.0396	-0.456
10:54:46	0	18.92	-0.4511	11:00:16	0	18.9653	-0.4521	11:05:16	0	18.9725	-0.4539	11:09:46	0	19.0185	-0.455	11:14:16	0	19.0323	-0.456
10:54:46	500	18.9172	-0.4503	11:00:16	500	18.9576	-0.4519	11:05:16	500	18.9671	-0.4539	11:09:46	500	19.0139	-0.4551	11:14:16	500	19.0256	-0.4558
10:54:47	0	18.9148	-0.4508	11:00:17	0	18.95	-0.4525	11:05:17	0	18.9632	-0.4538	11:09:47	0	19.0108	-0.4555	11:14:17	0	19.0204	-0.4561
10:54:47	500	18.9156	-0.4513	11:00:17	500	18.948	-0.452	11:05:17	500	18.9607	-0.4542	11:09:47	500	19.0074	-0.4552	11:14:17	500	19.0164	-0.4558
10:54:48	0	18.9138	-0.4512	11:00:18	0	18.9459	-0.4523	11:05:18	0	18.9586	-0.4541	11:09:48	0	19.0062	-0.4553	11:14:18	0	19.0133	-0.4556
10:54:48	500	18.9137	-0.451	11:00:18	500	18.9432	-0.4524	11:05:18	500	18.958	-0.4539	11:09:48	500	19.0049	-0.455	11:14:18	500	19.0117	-0.4558
10:54:49	0	18.914	-0.451	11:00:19	0	18.9423	-0.4522	11:05:19	0	18.9579	-0.4538	11:09:49	0	19.0048	-0.4551	11:14:19	0	19.0105	-0.4559
10:54:49	500	18.9135	-0.4516	11:00:19	500	18.9424	-0.4523	11:05:19	500	18.958	-0.4541	11:09:49	500	19.0052	-0.4551	11:14:19	500	19.0102	-0.4559
10:54:50	0	18.9141	-0.4513	11:00:20	0	18.941	-0.4521	11:05:20	0	18.9589	-0.4542	11:09:50	0	19.0053	-0.4553	11:14:20	0	19.0102	-0.4559
10:54:50	500	18.9137	-0.4518	11:00:20	500	18.9425	-0.452	11:05:20	500	18.9601	-0.4539	11:09:50	500	19.0065	-0.4551	11:14:20	500	19.0111	-0.4557
10:54:51	0	18.9153	-0.4513	11:00:21	0	18.9439	-0.452	11:05:21	0	18.9614	-0.4537	11:09:51	0	19.0076	-0.4551	11:14:21	0	19.0123	-0.4558
10:54:51	500	18.9152	-0.4512	11:00:21	500	18.9453	-0.4523	11:05:21	500	18.9626	-0.454	11:09:51	500	19.0087	-0.4554	11:14:21	500	19.0133	-0.4557
10:54:52	0	18.916	-0.4513	11:00:22	0	18.9465	-0.4521	11:05:22	0	18.964	-0.454	11:09:52	0	19.0096	-0.4549	11:14:22	0	19.0145	-0.4558

10:54:52	500	18.9168	-0.4518	11:00:22	500	18.9478	-0.4524	11:05:22	500	18.9653	-0.4538	11:09:52	500	19.0108	-0.4549	11:14:22	500	19.0158	-0.4559
10:54:53	0	18.9176	-0.4521	11:00:23	0	18.9495	-0.452	11:05:23	0	18.9666	-0.4539	11:09:53	0	19.0117	-0.4552	11:14:23	0	19.0171	-0.4558
10:54:53	500	18.916	-0.4514	11:00:23	500	18.9499	-0.4524	11:05:23	500	18.9675	-0.4541	11:09:53	500	19.0123	-0.4553	11:14:23	500	19.0183	-0.4557
10:54:54	0	18.9161	-0.4519	11:00:24	0	18.9511	-0.4524	11:05:24	0	18.9684	-0.4538	11:09:54	0	19.013	-0.455	11:14:24	0	19.0192	-0.456
10:54:54	500	18.9207	-0.451	11:00:24	500	18.9523	-0.4525	11:05:24	500	18.968	-0.4541	11:09:54	500	19.014	-0.4552	11:14:24	500	19.0198	-0.4558
10:54:55	0	18.9175	-0.4513	11:00:25	0	18.9524	-0.4527	11:05:25	0	18.969	-0.4542	11:09:55	0	19.0141	-0.4553	11:14:25	0	19.0207	-0.4559
10:54:55	500	18.9186	-0.4511	11:00:25	500	18.9539	-0.4525	11:05:25	500	18.9698	-0.4539	11:09:55	500	19.0146	-0.455	11:14:25	500	19.0213	-0.4559
10:54:56	0	18.9194	-0.4521	11:00:26	0	18.9544	-0.4523	11:05:26	0	18.9699	-0.4539	11:09:56	0	19.0148	-0.4552	11:14:26	0	19.0218	-0.4557
10:54:56	500	18.9187	-0.4521	11:00:26	500	18.954	-0.4522	11:05:26	500	18.9699	-0.4541	11:09:56	500	19.0149	-0.4551	11:14:26	500	19.0217	-0.4559
10:54:57	0	18.9187	-0.4525	11:00:27	0	18.9544	-0.4521	11:05:27	0	18.97	-0.4541	11:09:57	0	19.0147	-0.4551	11:14:27	0	19.0218	-0.4561
10:54:57	500	18.9187	-0.4518	11:00:27	500	18.9551	-0.452	11:05:27	500	18.97	-0.4538	11:09:57	500	19.015	-0.4553	11:14:27	500	19.0219	-0.4558
10:54:58	0	18.9182	-0.4518	11:00:28	0	18.9547	-0.4523	11:05:28	0	18.9699	-0.4542	11:09:58	0	19.0147	-0.4553	11:14:28	0	19.0222	-0.4559
10:54:58	500	18.9178	-0.4519	11:00:28	500	18.9544	-0.4526	11:05:28	500	18.9699	-0.4539	11:09:58	500	19.0149	-0.4552	11:14:28	500	19.0218	-0.4557
10:54:59	0	18.9177	-0.4519	11:00:29	0	18.9546	-0.4523	11:05:29	0	18.9696	-0.454	11:09:59	0	19.0145	-0.4552	11:14:29	0	19.0218	-0.4557
10:54:59	500	18.9185	-0.4514	11:00:29	500	18.9548	-0.4525	11:05:29	500	18.9695	-0.4541	11:09:59	500	19.0142	-0.4558	11:14:29	500	19.0217	-0.4559
10:55:00	0	18.9183	-0.4518	11:00:30	0	18.9539	-0.4528	11:05:30	0	18.9692	-0.4539	11:10:00	0	19.0142	-0.4555	11:14:30	0	19.0216	-0.4559

10:55:00	500	18.9182	-0.452	11:00:30	500	18.9537	-0.4528	11:05:30	500	18.9694	-0.454	11:10:00	500	19.0144	-0.455	11:14:30	500	19.0216	-0.4566
10:55:01	0	18.9166	-0.4521	11:00:31	0	18.9539	-0.4523	11:05:31	0	18.9691	-0.4541	11:10:01	0	19.0139	-0.4556	11:14:31	0	19.02	-0.4565
10:55:01	500	18.9178	-0.4518	11:00:31	500	18.9534	-0.4522	11:05:31	500	18.969	-0.4541	11:10:01	500	19.0138	-0.4551	11:14:31	500	19.0195	-0.4563
10:55:02	0	18.9181	-0.4521	11:00:32	0	18.9534	-0.4522	11:05:32	0	18.9689	-0.4538	11:10:02	0	19.0134	-0.4551	11:14:32	0	19.0213	-0.4558
10:55:02	500	18.9176	-0.4517	11:00:32	500	18.9538	-0.4531	11:05:32	500	18.9691	-0.4542	11:10:02	500	19.0139	-0.4551	11:14:32	500	19.022	-0.4559
10:55:03	0	18.9177	-0.4522	11:00:33	0	18.953	-0.4523	11:05:33	0	18.969	-0.4539	11:10:03	0	19.0136	-0.4551	11:14:33	0	19.0213	-0.4558
10:55:03	500	18.9175	-0.4519	11:00:33	500	18.9532	-0.4524	11:05:33	500	18.9685	-0.4542	11:10:03	500	19.0138	-0.4551	11:14:33	500	19.0193	-0.4559
10:55:04	0	18.9175	-0.4519	11:00:34	0	18.9542	-0.452	11:05:34	0	18.9689	-0.4539	11:10:04	0	19.014	-0.4552	11:14:34	0	19.0215	-0.456
10:55:04	500	18.9176	-0.4516	11:00:34	500	18.9539	-0.4518	11:05:34	500	18.9688	-0.454	11:10:04	500	19.0137	-0.4553	11:14:34	500	19.0205	-0.4563
10:55:05	0	18.9174	-0.4517	11:00:35	0	18.9535	-0.4525	11:05:35	0	18.9687	-0.4542	11:10:05	0	19.014	-0.455	11:14:35	0	19.0209	-0.457
10:55:05	500	18.9173	-0.4518	11:00:35	500	18.9541	-0.4521	11:05:35	500	18.9687	-0.4543	11:10:05	500	19.0138	-0.4551	11:14:35	500	19.0209	-0.4561
10:55:06	0	18.922	-0.4517	11:00:36	0	18.9538	-0.4522	11:05:36	0	18.9687	-0.4539	11:10:06	0	19.0136	-0.4553	11:14:36	0	19.0213	-0.4559
10:55:06	500	18.9218	-0.4518	11:00:36	500	18.9533	-0.4522	11:05:36	500	18.9685	-0.4542	11:10:06	500	19.014	-0.455	11:14:36	500	19.0215	-0.456
10:55:07	0	18.9217	-0.4515	11:00:37	0	18.9533	-0.4526	11:05:37	0	18.9688	-0.4543	11:10:07	0	19.014	-0.4551	11:14:37	0	19.0209	-0.456
10:55:07	500	18.9219	-0.4514	11:00:37	500	18.9539	-0.4524	11:05:37	500	18.9688	-0.4543	11:10:07	500	19.0139	-0.4548	11:14:37	500	19.0205	-0.4559
10:55:08	0	18.9217	-0.4518	11:00:38	0	18.9533	-0.452	11:05:38	0	18.9688	-0.4542	11:10:08	0	19.0138	-0.4553	11:14:38	0	19.0208	-0.4564

10:55:08	500	18.923	-0.4519	11:00:38	500	18.9518	-0.4524	11:05:38	500	18.969	-0.4538	11:10:08	500	19.0136	-0.455	11:14:38	500	19.0211	-0.4562
10:55:09	0	18.9228	-0.4519	11:00:39	0	18.9547	-0.4526	11:05:39	0	18.9687	-0.4541	11:10:09	0	19.014	-0.4549	11:14:39	0	19.0207	-0.456
10:55:09	500	18.9227	-0.4522	11:00:39	500	18.9536	-0.4524	11:05:39	500	18.9687	-0.4543	11:10:09	500	19.0138	-0.4553	11:14:39	500	19.0207	-0.4561
10:55:10	0	18.9223	-0.4519	11:00:40	0	18.9521	-0.4522	11:05:40	0	18.9688	-0.4543	11:10:10	0	19.0137	-0.4549	11:14:40	0	19.0214	-0.4557
10:55:10	500	18.9226	-0.4521	11:00:40	500	18.9547	-0.4523	11:05:40	500	18.9692	-0.4539	11:10:10	500	19.0139	-0.4553	11:14:40	500	19.0208	-0.4557
10:55:11	0	18.9226	-0.4501	11:00:41	0	18.9544	-0.4521	11:05:41	0	18.9692	-0.454	11:10:11	0	19.0138	-0.4551	11:14:41	0	19.0213	-0.4558
10:55:11	500	18.9239	-0.4521	11:00:41	500	18.9536	-0.4526	11:05:41	500	18.9688	-0.4542	11:10:11	500	19.0139	-0.4552	11:14:41	500	19.0209	-0.4557
10:55:12	0	18.9245	-0.4521	11:00:42	0	18.9539	-0.4522	11:05:42	0	18.9693	-0.4539	11:10:12	0	19.0138	-0.4554	11:14:42	0	19.0211	-0.4556
10:55:12	500	18.925	-0.4516	11:00:42	500	18.9538	-0.4523	11:05:42	500	18.9691	-0.454	11:10:12	500	19.0141	-0.4553	11:14:42	500	19.021	-0.456
10:55:13	0	18.9249	-0.451	11:00:43	0	18.9536	-0.4521	11:05:43	0	18.9693	-0.454	11:10:13	0	19.014	-0.4551	11:14:43	0	19.0213	-0.4563
10:55:13	500	18.9251	-0.4518	11:00:43	500	18.9533	-0.4523	11:05:43	500	18.9692	-0.4539	11:10:13	500	19.0134	-0.4553	11:14:43	500	19.0214	-0.4555
10:55:14	0	18.925	-0.4514	11:00:44	0	18.9534	-0.4523	11:05:44	0	18.9689	-0.4539	11:10:14	0	19.0139	-0.4551	11:14:44	0	19.0214	-0.4558
10:55:14	500	18.9249	-0.4518	11:00:44	500	18.9539	-0.4525	11:05:44	500	18.9692	-0.454	11:10:14	500	19.0136	-0.455	11:14:44	500	19.021	-0.456
10:55:15	0	18.9251	-0.452	11:00:45	0	18.9535	-0.4528	11:05:45	0	18.9695	-0.4542	11:10:15	0	19.014	-0.4551	11:14:45	0	19.0211	-0.4558
10:55:15	500	18.9248	-0.4521	11:00:45	500	18.9535	-0.4527	11:05:45	500	18.9689	-0.4542	11:10:15	500	19.0139	-0.4552	11:14:45	500	19.021	-0.4559
10:55:16	0	18.9249	-0.4518	11:00:46	0	18.9536	-0.4523	11:05:46	0	18.9692	-0.4539	11:10:16	0	19.0137	-0.4551	11:14:46	0	19.0207	-0.4558

10:55:16	500	18.926	-0.4521	11:00:46	500	18.9534	-0.4524	11:05:46	500	18.9692	-0.454	11:10:16	500	19.0141	-0.4552	11:14:46	500	19.0208	-0.4557
10:55:17	0	18.9261	-0.4524	11:00:47	0	18.9536	-0.4521	11:05:47	0	18.9688	-0.4542	11:10:17	0	19.0136	-0.4552	11:14:47	0	19.0204	-0.4559
10:55:17	500	18.9257	-0.4519	11:00:47	500	18.9541	-0.4523	11:05:47	500	18.969	-0.454	11:10:17	500	19.0139	-0.4552	11:14:47	500	19.0211	-0.4558
10:55:18	0	18.9257	-0.4521	11:00:48	0	18.9547	-0.4524	11:05:48	0	18.9693	-0.454	11:10:18	0	19.0139	-0.4552	11:14:48	0	19.0212	-0.4558
10:55:18	500	18.926	-0.4522	11:00:48	500	18.9545	-0.4523	11:05:48	500	18.9688	-0.4539	11:10:18	500	19.0139	-0.4553	11:14:48	500	19.0208	-0.4557
10:55:19	0	18.9261	-0.4519	11:00:49	0	18.9547	-0.4523	11:05:49	0	18.9691	-0.454	11:10:19	0	19.0139	-0.4551	11:14:49	0	19.0211	-0.456
10:55:19	500	18.926	-0.452	11:00:49	500	18.9548	-0.4526	11:05:49	500	18.9689	-0.4542	11:10:19	500	19.0139	-0.4552	11:14:49	500	19.0214	-0.4559
10:55:20	0	18.9262	-0.4521	11:00:50	0	18.9548	-0.4525	11:05:50	0	18.9689	-0.454	11:10:20	0	19.0137	-0.4556	11:14:50	0	19.0208	-0.4557
10:55:20	500	18.9259	-0.452	11:00:50	500	18.9543	-0.4526	11:05:50	500	18.9691	-0.4542	11:10:20	500	19.0135	-0.4552	11:14:50	500	19.0208	-0.4559
10:55:21	0	18.926	-0.452	11:00:51	0	18.9547	-0.4525	11:05:51	0	18.9691	-0.4544	11:10:21	0	19.014	-0.4553	11:14:51	0	19.0211	-0.4559
10:55:21	500	18.926	-0.4521	11:00:51	500	18.9541	-0.4526	11:05:51	500	18.9691	-0.4542	11:10:21	500	19.0138	-0.4555	11:14:51	500	19.0209	-0.4559
10:55:22	0	18.9259	-0.452	11:00:52	0	18.9548	-0.4527	11:05:52	0	18.9689	-0.4541	11:10:22	0	19.0137	-0.455	11:14:52	0	19.021	-0.4561
10:55:22	500	18.9262	-0.4521	11:00:52	500	18.9545	-0.4523	11:05:52	500	18.9692	-0.4539	11:10:22	500	19.0138	-0.4552	11:14:52	500	19.0214	-0.4557
10:55:23	0	18.9261	-0.4517	11:00:53	0	18.9545	-0.4524	11:05:53	0	18.9691	-0.4542	11:10:23	0	19.0137	-0.4555	11:14:53	0	19.021	-0.4561
10:55:23	500	18.926	-0.4519	11:00:53	500	18.9549	-0.4524	11:05:53	500	18.9689	-0.4544	11:10:23	500	19.0137	-0.4552	11:14:53	500	19.021	-0.4558
10:55:24	0	18.9261	-0.4519	11:00:54	0	18.9547	-0.4527	11:05:54	0	18.9689	-0.4542	11:10:24	0	19.0139	-0.455	11:14:54	0	19.0209	-0.4559

10:55:24	500	18.9265	-0.4521	11:00:54	500	18.9548	-0.4528	11:05:54	500	18.9691	-0.4542	11:10:24	500	19.0138	-0.4551	11:14:54	500	19.0207	-0.4561
10:55:25	0	18.9265	-0.4519	11:00:55	0	18.955	-0.4527	11:05:55	0	18.9689	-0.4541	11:10:25	0	19.0138	-0.4552	11:14:55	0	19.0211	-0.456
10:55:25	500	18.9268	-0.452	11:00:55	500	18.9547	-0.4526	11:05:55	500	18.9689	-0.454	11:10:25	500	19.0138	-0.455	11:14:55	500	19.0211	-0.4559
10:55:26	0	18.9274	-0.4517	11:00:56	0	18.954	-0.4527	11:05:56	0	18.9692	-0.4539	11:10:26	0	19.0139	-0.4551	11:14:56	0	19.0208	-0.4559
10:55:26	500	18.9273	-0.4517	11:00:56	500	18.9544	-0.4526	11:05:56	500	18.9691	-0.4543	11:10:26	500	19.0139	-0.4551	11:14:56	500	19.021	-0.4561
10:55:27	0	18.9269	-0.4521	11:00:57	0	18.9548	-0.4527	11:05:57	0	18.969	-0.4541	11:10:27	0	19.0141	-0.455	11:14:57	0	19.021	-0.4557
10:55:27	500	18.9269	-0.4519	11:00:57	500	18.9548	-0.4525	11:05:57	500	18.9691	-0.454	11:10:27	500	19.014	-0.4551	11:14:57	500	19.0209	-0.4558
10:55:28	0	18.9268	-0.452	11:00:58	0	18.9545	-0.4525	11:05:58	0	18.9689	-0.4539	11:10:28	0	19.014	-0.4548	11:14:58	0	19.0209	-0.4557
10:55:28	500	18.927	-0.4518	11:00:58	500	18.9548	-0.4526	11:05:58	500	18.9687	-0.4539	11:10:28	500	19.0138	-0.4551	11:14:58	500	19.0213	-0.4556
10:55:29	0	18.9269	-0.4521	11:00:59	0	18.954	-0.4528	11:05:59	0	18.9691	-0.4541	11:10:29	0	19.0139	-0.4552	11:14:59	0	19.0211	-0.4556
10:55:29	500	18.9268	-0.452	11:00:59	500	18.9549	-0.453	11:05:59	500	18.9688	-0.4543	11:10:29	500	19.0137	-0.4551	11:14:59	500	19.0209	-0.4555
10:55:30	0	18.9268	-0.4521	11:01:00	0	18.9547	-0.4526	11:06:00	0	18.9694	-0.4543	11:10:30	0	19.0141	-0.455	11:15:00	0	19.0212	-0.4556

Table B2. Levelogger and Barologger data for pneumatic slug testing on July 16, 2014 at well 1D.

Test #1				Test #2				Test #3				Test #4				Test #5			
Time	ms	Level	Baro	Time	ms	Level	Baro	Time	ms	Level	Baro	Time	ms	Level	Baro	Time	ms	Level	Baro
9:34:20 AM	0	16.2382	0.9097	9:39:20	0	16.2188	0.9223	9:45:35	0	16.2406	0.908	9:51:20	0	16.2431	0.9068	9:55:20	0	16.246	0.9063
9:34:20 AM	500	16.2383	0.9093	9:39:20	500	16.2144	0.9186	9:45:35	500	16.2407	0.908	9:51:20	500	16.2428	0.9069	9:55:20	500	16.2459	0.9062
9:34:21 AM	0	16.2382	0.9096	9:39:21	0	16.2131	0.9114	9:45:36	0	16.2403	0.9081	9:51:21	0	16.2432	0.9068	9:55:21	0	16.2458	0.9061
9:34:21 AM	500	16.2383	0.9098	9:39:21	500	16.2142	0.9101	9:45:36	500	16.2404	0.908	9:51:21	500	16.2433	0.9069	9:55:21	500	16.268	0.9062
9:34:22 AM	0	16.2384	0.9097	9:39:22	0	16.2165	0.9101	9:45:37	0	16.2405	0.908	9:51:22	0	16.2435	0.9069	9:55:22	0	16.2594	0.9197
9:34:22 AM	500	16.2384	0.9097	9:39:22	500	16.2195	0.9102	9:45:37	500	16.2408	0.9082	9:51:22	500	16.2436	0.9068	9:55:22	500	16.245	0.9257
9:34:23 AM	0	16.2383	0.9094	9:39:23	0	16.2223	0.9108	9:45:38	0	16.2408	0.9081	9:51:23	0	16.2439	0.9067	9:55:23	0	16.257	0.9087
9:34:23 AM	500	16.2386	0.9095	9:39:23	500	16.2255	0.9111	9:45:38	500	16.2407	0.908	9:51:23	500	16.244	0.9067	9:55:23	500	16.2867	0.9297
9:34:24 AM	0	16.2383	0.9097	9:39:24	0	16.2282	0.9111	9:45:39	0	16.2406	0.9081	9:51:24	0	16.2443	0.9069	9:55:24	0	16.2651	0.9639
9:34:24 AM	500	16.2382	0.9097	9:39:24	500	16.2311	0.9108	9:45:39	500	16.2407	0.9081	9:51:24	500	16.2444	0.9067	9:55:24	500	16.2423	0.9422
9:34:25 AM	0	16.2382	0.9095	9:39:25	0	16.2336	0.91	9:45:40	0	16.2407	0.9081	9:51:25	0	16.2446	0.9067	9:55:25	0	16.2387	0.9144
9:34:25 AM	500	16.2382	0.9097	9:39:25	500	16.2357	0.91	9:45:40	500	16.2408	0.9081	9:51:25	500	16.2444	0.907	9:55:25	500	16.2344	0.9077
9:34:26 AM	0	16.2382	0.9095	9:39:26	0	16.2377	0.9099	9:45:41	0	16.2406	0.9079	9:51:26	0	16.2449	0.9071	9:55:26	0	16.2444	0.9064
9:34:26 AM	500	16.2381	0.9096	9:39:26	500	16.2387	0.9098	9:45:41	500	16.2409	0.9081	9:51:26	500	16.2449	0.9072	9:55:26	500	16.249	0.9178
9:34:27 AM	0	16.238	0.9097	9:39:27	0	16.2411	0.9103	9:45:42	0	16.2406	0.908	9:51:27	0	16.2448	0.907	9:55:27	0	16.2599	0.9304
9:34:27 AM	500	16.2385	0.9096	9:39:27	500	16.2413	0.9113	9:45:42	500	16.2406	0.908	9:51:27	500	16.2447	0.9071	9:55:27	500	16.2634	0.943
9:34:28 AM	0	16.2382	0.9095	9:39:28	0	16.2417	0.9117	9:45:43	0	16.2409	0.908	9:51:28	0	16.2447	0.9068	9:55:28	0	16.2679	0.9517
9:34:28 AM	500	16.2383	0.9096	9:39:28	500	16.2408	0.9102	9:45:43	500	16.2404	0.9081	9:51:28	500	16.2444	0.9068	9:55:28	500	16.2638	0.9569
9:34:29 AM	0	16.2381	0.9096	9:39:29	0	16.2409	0.9088	9:45:44	0	16.2405	0.9079	9:51:29	0	16.2445	0.9068	9:55:29	0	16.278	0.9558
9:34:29 AM	500	16.2383	0.9096	9:39:29	500	16.3231	0.9093	9:45:44	500	16.2406	0.9078	9:51:29	500	16.2481	0.907	9:55:29	500	16.2906	0.9624

9:34:30 AM	0	16.2504	0.9096	9:39:30	0	16.4355	0.9886	9:45:45	0	16.2406	0.908	9:51:30	0	16.2513	0.9149	9:55:30	0	16.3016	0.9988
9:34:30 AM	500	16.3984	0.9124	9:39:30	500	16.5032	1.1635	9:45:45	500	16.2404	0.908	9:51:30	500	16.2495	0.9158	9:55:30	500	16.3037	1.0168
9:34:31 AM	0	16.4917	1.0996	9:39:31	0	16.554	1.2802	9:45:46	0	16.2405	0.908	9:51:31	0	16.2495	0.9153	9:55:31	0	16.3025	1.0281
9:34:31 AM	500	16.5562	1.2556	9:39:31	500	16.5793	1.368	9:45:46	500	16.2405	0.9077	9:51:31	500	16.2487	0.9151	9:55:31	500	16.2978	1.0341
9:34:32 AM	0	16.5982	1.3657	9:39:32	0	16.5847	1.4346	9:45:47	0	16.2409	0.908	9:51:32	0	16.2478	0.9145	9:55:32	0	16.291	1.0375
9:34:32 AM	500	16.6135	1.4473	9:39:32	500	16.5728	1.4835	9:45:47	500	16.2404	0.9079	9:51:32	500	16.2467	0.9143	9:55:32	500	16.2833	1.0384
9:34:33 AM	0	16.6046	1.5087	9:39:33	0	16.5494	1.5196	9:45:48	0	16.2408	0.908	9:51:33	0	16.246	0.9142	9:55:33	0	16.2756	1.0393
9:34:33 AM	500	16.5787	1.5497	9:39:33	500	16.5189	1.5472	9:45:48	500	16.2407	0.9081	9:51:33	500	16.2452	0.9139	9:55:33	500	16.2682	1.0399
9:34:34 AM	0	16.5472	1.5731	9:39:34	0	16.4857	1.5715	9:45:49	0	16.2406	0.908	9:51:34	0	16.2445	0.9139	9:55:34	0	16.2622	1.0408
9:34:34 AM	500	16.5041	1.5988	9:39:34	500	16.452	1.5953	9:45:49	500	16.2409	0.9079	9:51:34	500	16.244	0.9136	9:55:34	500	16.2569	1.0426
9:34:35 AM	0	16.462	1.6136	9:39:35	0	16.4186	1.618	9:45:50	0	16.2405	0.9077	9:51:35	0	16.244	0.9138	9:55:35	0	16.2522	1.0438
9:34:35 AM	500	16.4243	1.627	9:39:35	500	16.3875	1.6382	9:45:50	500	16.2407	0.9079	9:51:35	500	16.2434	0.9136	9:55:35	500	16.2487	1.0452
9:34:36 AM	0	16.3937	1.6447	9:39:36	0	16.3599	1.6578	9:45:51	0	16.2408	0.9082	9:51:36	0	16.2433	0.9137	9:55:36	0	16.2455	1.0466
9:34:36 AM	500	16.3681	1.6683	9:39:36	500	16.3374	1.6756	9:45:51	500	16.241	0.9079	9:51:36	500	16.2432	0.9136	9:55:36	500	16.2434	1.0474
9:34:37 AM	0	16.3482	1.6929	9:39:37	0	16.3196	1.6955	9:45:52	0	16.2403	0.9081	9:51:37	0	16.2433	0.9133	9:55:37	0	16.2419	1.0482
9:34:37 AM	500	16.3331	1.7187	9:39:37	500	16.3053	1.7153	9:45:52	500	16.2406	0.908	9:51:37	500	16.2431	0.9133	9:55:37	500	16.2414	1.049
9:34:38 AM	0	16.3224	1.7459	9:39:38	0	16.2929	1.7345	9:45:53	0	16.2409	0.9082	9:51:38	0	16.2434	0.9133	9:55:38	0	16.2407	1.0497
9:34:38 AM	500	16.315	1.7725	9:39:38	500	16.2821	1.752	9:45:53	500	16.2407	0.9081	9:51:38	500	16.2433	0.913	9:55:38	500	16.2407	1.0505
9:34:39 AM	0	16.3107	1.7981	9:39:39	0	16.2751	1.7653	9:45:54	0	16.2404	0.9079	9:51:39	0	16.2436	0.9132	9:55:39	0	16.2409	1.0508
9:34:39 AM	500	16.3081	1.8237	9:39:39	500	16.2696	1.7795	9:45:54	500	16.2405	0.908	9:51:39	500	16.2435	0.9127	9:55:39	500	16.2423	1.0509
9:34:40 AM	0	16.305	1.8491	9:39:40	0	16.2658	1.7933	9:45:55	0	16.2409	0.9077	9:51:40	0	16.2437	0.9128	9:55:40	0	16.2438	1.0526
9:34:40 AM	500	16.3019	1.8703	9:39:40	500	16.2634	1.8049	9:45:55	500	16.2408	0.9079	9:51:40	500	16.2438	0.9125	9:55:40	500	16.244	1.0543
9:34:41 AM	0	16.2951	1.8892	9:39:41	0	16.2614	1.8163	9:45:56	0	16.2406	0.908	9:51:41	0	16.2438	0.9125	9:55:41	0	16.2438	1.0542
9:34:41 AM	500	16.29	1.9013	9:39:41	500	16.2608	1.826	9:45:56	500	16.2405	0.9078	9:51:41	500	16.2439	0.9122	9:55:41	500	16.244	1.0534

9:34:42 AM	0	16.2856	1.9126	9:39:42	0	16.2624	1.8352	9:45:57	0	16.2407	0.9079	9:51:42	0	16.2441	0.9121	9:55:42	0	16.2434	1.0521
9:34:42 AM	500	16.2821	1.9254	9:39:42	500	16.2643	1.8475	9:45:57	500	16.2406	0.9079	9:51:42	500	16.2443	0.9122	9:55:42	500	16.2434	1.0511
9:34:43 AM	0	16.2789	1.9368	9:39:43	0	16.2724	1.8572	9:45:58	0	16.2403	0.9079	9:51:43	0	16.2441	0.9123	9:55:43	0	16.2438	1.0507
9:34:43 AM	500	16.2754	1.9478	9:39:43	500	16.2826	1.8744	9:45:58	500	16.2407	0.9078	9:51:43	500	16.2444	0.912	9:55:43	500	16.2436	1.0502
9:34:44 AM	0	16.2726	1.9573	9:39:44	0	16.2923	1.8969	9:45:59	0	16.2404	0.9079	9:51:44	0	16.2442	0.9119	9:55:44	0	16.2435	1.0503
9:34:44 AM	500	16.2697	1.9666	9:39:44	500	16.2996	1.9184	9:45:59	500	16.2406	0.9081	9:51:44	500	16.2442	0.9118	9:55:44	500	16.2435	1.0494
9:34:45 AM	0	16.268	1.9746	9:39:45	0	16.3056	1.9381	9:46:00	0	16.2407	0.9078	9:51:45	0	16.2443	0.9118	9:55:45	0	16.2432	1.049
9:34:45 AM	500	16.2661	1.9829	9:39:45	500	16.3096	1.9559	9:46:00	500	16.2406	0.9081	9:51:45	500	16.2443	0.9118	9:55:45	500	16.2435	1.0483
9:34:46 AM	0	16.2641	1.9914	9:39:46	0	16.3052	1.9742	9:46:01	0	16.2406	0.9078	9:51:46	0	16.2442	0.9117	9:55:46	0	16.2432	1.0474
9:34:46 AM	500	16.2629	1.9976	9:39:46	500	16.2979	1.9834	9:46:01	500	16.2403	0.9078	9:51:46	500	16.2442	0.9117	9:55:46	500	16.2432	1.0471
9:34:47 AM	0	16.2622	2.0048	9:39:47	0	16.2903	1.9867	9:46:02	0	16.2409	0.9077	9:51:47	0	16.2443	0.9117	9:55:47	0	16.2433	1.0468
9:34:47 AM	500	16.2624	2.0119	9:39:47	500	16.2891	1.9887	9:46:02	500	16.2404	0.908	9:51:47	500	16.2442	0.9114	9:55:47	500	16.2434	1.0456
9:34:48 AM	0	16.2601	2.0192	9:39:48	0	16.2908	2.0009	9:46:03	0	16.2406	0.9078	9:51:48	0	16.244	0.9116	9:55:48	0	16.2434	1.0454
9:34:48 AM	500	16.2586	2.0244	9:39:48	500	16.2904	2.0184	9:46:03	500	16.2408	0.9077	9:51:48	500	16.2441	0.9113	9:55:48	500	16.2437	1.0449
9:34:49 AM	0	16.2567	2.0288	9:39:49	0	16.2896	2.0331	9:46:04	0	16.2405	0.908	9:51:49	0	16.2441	0.9111	9:55:49	0	16.2438	1.0447
9:34:49 AM	500	16.2559	2.0327	9:39:49	500	16.2904	2.0453	9:46:04	500	16.2408	0.9079	9:51:49	500	16.2442	0.9111	9:55:49	500	16.2436	1.0442
9:34:50 AM	0	16.2547	2.0371	9:39:50	0	16.2912	2.0594	9:46:05	0	16.2407	0.9078	9:51:50	0	16.2442	0.9111	9:55:50	0	16.2432	1.0437
9:34:50 AM	500	16.2539	2.0414	9:39:50	500	16.289	2.0736	9:46:05	500	16.2405	0.9076	9:51:50	500	16.2445	0.9111	9:55:50	500	16.2437	1.0428
9:34:51 AM	0	16.2526	2.0455	9:39:51	0	16.2837	2.0859	9:46:06	0	16.2406	0.908	9:51:51	0	16.244	0.911	9:55:51	0	16.2436	1.0421
9:34:51 AM	500	16.2517	2.0486	9:39:51	500	16.2747	2.0919	9:46:06	500	16.2408	0.9077	9:51:51	500	16.2442	0.911	9:55:51	500	16.2438	1.0416
9:34:52 AM	0	16.2513	2.052	9:39:52	0	16.2675	2.0932	9:46:07	0	16.2406	0.9081	9:51:52	0	16.244	0.9113	9:55:52	0	16.2437	1.0414
9:34:52 AM	500	16.2507	2.0549	9:39:52	500	16.2606	2.0948	9:46:07	500	16.2407	0.908	9:51:52	500	16.2445	0.9107	9:55:52	500	16.2435	1.0406
9:34:53 AM	0	16.2511	2.0589	9:39:53	0	16.255	2.096	9:46:08	0	16.2406	0.9079	9:51:53	0	16.2441	0.9108	9:55:53	0	16.2438	1.04
9:34:53 AM	500	16.2503	2.0632	9:39:53	500	16.2508	2.0982	9:46:08	500	16.2406	0.908	9:51:53	500	16.2443	0.9107	9:55:53	500	16.2438	1.0392

9:34:54 AM	0	16.2472	2.0658	9:39:54	0	16.2471	2.1015	9:46:09	0	16.2411	0.9083	9:51:54	0	16.2444	0.911	9:55:54	0	16.244	1.0392
9:34:54 AM	500	16.243	2.067	9:39:54	500	16.2426	2.1049	9:46:09	500	16.2407	0.9078	9:51:54	500	16.2445	0.9106	9:55:54	500	16.2441	1.0387
9:34:55 AM	0	16.2454	2.0612	9:39:55	0	16.2397	2.1055	9:46:10	0	16.2407	0.9081	9:51:55	0	16.2443	0.9103	9:55:55	0	16.2439	1.0382
9:34:55 AM	500	16.2583	2.0668	9:39:55	500	16.2383	2.1057	9:46:10	500	16.2406	0.9078	9:51:55	500	16.2444	0.9104	9:55:55	500	16.2442	1.0379
9:34:56 AM	0	16.2679	2.0835	9:39:56	0	16.2374	2.1072	9:46:11	0	16.2403	0.9081	9:51:56	0	16.2443	0.9107	9:55:56	0	16.2444	1.0376
9:34:56 AM	500	16.2739	2.1015	9:39:56	500	16.2382	2.1094	9:46:11	500	16.2409	0.908	9:51:56	500	16.2441	0.9102	9:55:56	500	16.2442	1.0369
9:34:57 AM	0	16.2766	2.115	9:39:57	0	16.2384	2.1118	9:46:12	0	16.2409	0.9079	9:51:57	0	16.2442	0.9105	9:55:57	0	16.2445	1.0368
9:34:57 AM	500	16.2767	2.1232	9:39:57	500	16.2396	2.1139	9:46:12	500	16.2407	0.9077	9:51:57	500	16.2441	0.9105	9:55:57	500	16.2446	1.0364
9:34:58 AM	0	16.2751	2.1287	9:39:58	0	16.2409	2.1162	9:46:13	0	16.2407	0.9076	9:51:58	0	16.2441	0.9104	9:55:58	0	16.2441	1.0359
9:34:58 AM	500	16.2719	2.1321	9:39:58	500	16.2414	2.1188	9:46:13	500	16.2407	0.9081	9:51:58	500	16.2443	0.91	9:55:58	500	16.2443	1.0354
9:34:59 AM	0	16.2689	2.135	9:39:59	0	16.2418	2.1205	9:46:14	0	16.2407	0.9081	9:51:59	0	16.2439	0.9103	9:55:59	0	16.2447	1.0351
9:34:59 AM	500	16.2654	2.1384	9:39:59	500	16.2416	2.1209	9:46:14	500	16.2406	0.9079	9:51:59	500	16.2444	0.9101	9:55:59	500	16.2446	1.0351
9:35:00 AM	0	16.2621	2.1418	9:40:00	0	16.2415	2.1216	9:46:15	0	16.2406	0.9078	9:52:00	0	16.244	0.9103	9:56:00	0	16.2445	1.0344
9:35:00 AM	500	16.2592	2.1451	9:40:00	500	16.2404	2.1215	9:46:15	500	16.2406	0.9077	9:52:00	500	16.2443	0.9103	9:56:00	500	16.2447	1.0342
9:35:01 AM	0	16.257	2.1486	9:40:01	0	16.2403	2.121	9:46:16	0	16.2407	0.9079	9:52:01	0	16.2442	0.9103	9:56:01	0	16.2448	1.0338
9:35:01 AM	500	16.2545	2.1518	9:40:01	500	16.2399	2.1203	9:46:16	500	16.2406	0.9076	9:52:01	500	16.2442	0.9101	9:56:01	500	16.2447	1.0336
9:35:02 AM	0	16.2526	2.1553	9:40:02	0	16.2393	2.1203	9:46:17	0	16.2408	0.9078	9:52:02	0	16.2441	0.9101	9:56:02	0	16.2451	1.0333
9:35:02 AM	500	16.2511	2.1586	9:40:02	500	16.2389	2.1203	9:46:17	500	16.2408	0.9079	9:52:02	500	16.2445	0.9101	9:56:02	500	16.2447	1.0331
9:35:03 AM	0	16.2505	2.1617	9:40:03	0	16.2382	2.12	9:46:18	0	16.2407	0.908	9:52:03	0	16.2443	0.9102	9:56:03	0	16.2445	1.0327
9:35:03 AM	500	16.2478	2.1651	9:40:03	500	16.2367	2.1191	9:46:18	500	16.2405	0.9079	9:52:03	500	16.2443	0.91	9:56:03	500	16.2446	1.0322
9:35:04 AM	0	16.2458	2.1677	9:40:04	0	16.2359	2.1173	9:46:19	0	16.2405	0.9078	9:52:04	0	16.2444	0.9097	9:56:04	0	16.244	1.0315
9:35:04 AM	500	16.2459	2.1666	9:40:04	500	16.2349	2.1161	9:46:19	500	16.2409	0.9079	9:52:04	500	16.2441	0.91	9:56:04	500	16.2444	1.0311
9:35:05 AM	0	16.2469	2.1698	9:40:05	0	16.235	2.1146	9:46:20	0	16.2406	0.9081	9:52:05	0	16.2443	0.91	9:56:05	0	16.2443	1.0304
9:35:05 AM	500	16.2475	2.174	9:40:05	500	16.2348	2.1134	9:46:20	500	16.2405	0.9081	9:52:05	500	16.244	0.9099	9:56:05	500	16.2443	1.03

9:35:06 AM	0	16.2474	2.1777	9:40:06	0	16.236	2.1133	9:46:21	0	16.2408	0.9078	9:52:06	0	16.2445	0.9095	9:56:06	0	16.2442	1.03
9:35:06 AM	500	16.247	2.1798	9:40:06	500	16.237	2.113	9:46:21	500	16.2409	0.9077	9:52:06	500	16.2442	0.9094	9:56:06	500	16.2443	1.0297
9:35:07 AM	0	16.2473	2.1812	9:40:07	0	16.2381	2.1138	9:46:22	0	16.2406	0.908	9:52:07	0	16.2441	0.9096	9:56:07	0	16.2444	1.0294
9:35:07 AM	500	16.2467	2.1837	9:40:07	500	16.2391	2.1148	9:46:22	500	16.2406	0.9077	9:52:07	500	16.2444	0.9096	9:56:07	500	16.2447	1.0294
9:35:08 AM	0	16.2458	2.1851	9:40:08	0	16.2399	2.1153	9:46:23	0	16.2406	0.9078	9:52:08	0	16.2441	0.9095	9:56:08	0	16.2448	1.0292
9:35:08 AM	500	16.2438	2.1855	9:40:08	500	16.2406	2.1157	9:46:23	500	16.2408	0.9078	9:52:08	500	16.2445	0.9094	9:56:08	500	16.2449	1.0288
9:35:09 AM	0	16.2419	2.1848	9:40:09	0	16.2408	2.1158	9:46:24	0	16.2407	0.9079	9:52:09	0	16.244	0.9093	9:56:09	0	16.2449	1.0286
9:35:09 AM	500	16.2405	2.1839	9:40:09	500	16.2409	2.1155	9:46:24	500	16.2407	0.908	9:52:09	500	16.2442	0.9097	9:56:09	500	16.2449	1.0282
9:35:10 AM	0	16.2399	2.1831	9:40:10	0	16.241	2.1152	9:46:25	0	16.2406	0.9077	9:52:10	0	16.2445	0.9097	9:56:10	0	16.2451	1.0283
9:35:10 AM	500	16.242	2.1837	9:40:10	500	16.2409	2.1153	9:46:25	500	16.2404	0.9077	9:52:10	500	16.244	0.9095	9:56:10	500	16.2451	1.028
9:35:11 AM	0	16.244	2.1863	9:40:11	0	16.2404	2.1149	9:46:26	0	16.2405	0.9078	9:52:11	0	16.2444	0.9095	9:56:11	0	16.2451	1.0277
9:35:11 AM	500	16.2457	2.1908	9:40:11	500	16.24	2.1144	9:46:26	500	16.2403	0.9077	9:52:11	500	16.2441	0.9093	9:56:11	500	16.2453	1.0273
9:35:12 AM	0	16.2471	2.1936	9:40:12	0	16.2398	2.1138	9:46:27	0	16.2407	0.9078	9:52:12	0	16.2443	0.9094	9:56:12	0	16.2452	1.0273
9:35:12 AM	500	16.2478	2.1966	9:40:12	500	16.2394	2.1135	9:46:27	500	16.241	0.9078	9:52:12	500	16.2443	0.9095	9:56:12	500	16.2455	1.0271
9:35:13 AM	0	16.2489	2.1986	9:40:13	0	16.2393	2.1135	9:46:28	0	16.2406	0.9078	9:52:13	0	16.2444	0.9094	9:56:13	0	16.2453	1.0271
9:35:13 AM	500	16.2485	2.2007	9:40:13	500	16.2393	2.113	9:46:28	500	16.2406	0.9079	9:52:13	500	16.2442	0.9093	9:56:13	500	16.2455	1.0268
9:35:14 AM	0	16.2478	2.2021	9:40:14	0	16.2383	2.1127	9:46:29	0	16.2408	0.9078	9:52:14	0	16.2445	0.9094	9:56:14	0	16.2453	1.0267
9:35:14 AM	500	16.247	2.2024	9:40:14	500	16.2241	2.1137	9:46:29	500	16.2404	0.9077	9:52:14	500	16.2444	0.9097	9:56:14	500	16.2451	1.0263
9:35:15 AM	0	16.2457	2.2032	9:40:15	0	16.2135	2.0956	9:46:30	0	16.2407	0.9081	9:52:15	0	16.2442	0.9094	9:56:15	0	16.2452	1.0265
9:35:15 AM	500	16.2422	2.2039	9:40:15	500	16.2092	2.078	9:46:30	500	16.2407	0.9077	9:52:15	500	16.2444	0.9095	9:56:15	500	16.2453	1.0261
9:35:16 AM	0	16.2404	2.2004	9:40:16	0	16.2069	2.0693	9:46:31	0	16.2406	0.9077	9:52:16	0	16.2446	0.9093	9:56:16	0	16.2454	1.0259
9:35:16 AM	500	16.2398	2.1994	9:40:16	500	16.2062	2.0631	9:46:31	500	16.2409	0.9079	9:52:16	500	16.2446	0.9091	9:56:16	500	16.2449	1.0258
9:35:17 AM	0	16.2396	2.1996	9:40:17	0	16.2108	2.0582	9:46:32	0	16.2405	0.9076	9:52:17	0	16.2444	0.9093	9:56:17	0	16.2455	1.0255
9:35:17 AM	500	16.2397	2.2001	9:40:17	500	16.2206	2.0563	9:46:32	500	16.241	0.9075	9:52:17	500	16.2442	0.9096	9:56:17	500	16.2452	1.0255

9:35:18 AM	0	16.2399	2.201	9:40:18	0	16.2233	2.0652	9:46:33	0	16.2403	0.9077	9:52:18	0	16.244	0.9094	9:56:18	0	16.2453	1.0255
9:35:18 AM	500	16.241	2.202	9:40:18	500	16.2239	2.0657	9:46:33	500	16.2407	0.9078	9:52:18	500	16.2443	0.9092	9:56:18	500	16.2453	1.0252
9:35:19 AM	0	16.241	2.2032	9:40:19	0	16.2265	2.0592	9:46:34	0	16.2404	0.9078	9:52:19	0	16.244	0.9093	9:56:19	0	16.2451	1.0249
9:35:19 AM	500	16.2321	2.2048	9:40:19	500	16.2292	2.0565	9:46:34	500	16.2408	0.908	9:52:19	500	16.2442	0.9093	9:56:19	500	16.2452	1.0247
9:35:20 AM	0	16.2229	2.1951	9:40:20	0	16.2301	2.0546	9:46:35	0	16.2409	0.9078	9:52:20	0	16.2442	0.9092	9:56:20	0	16.2453	1.0244
9:35:20 AM	500	16.2156	2.1813	9:40:20	500	16.2302	2.0519	9:46:35	500	16.2407	0.9079	9:52:20	500	16.2443	0.9093	9:56:20	500	16.2454	1.0243
9:35:21 AM	0	16.2101	2.1702	9:40:21	0	16.2311	2.0477	9:46:36	0	16.2407	0.9078	9:52:21	0	16.2444	0.9092	9:56:21	0	16.2452	1.0243
9:35:21 AM	500	16.2059	2.1606	9:40:21	500	16.2317	2.0445	9:46:36	500	16.2408	0.9076	9:52:21	500	16.2442	0.9093	9:56:21	500	16.2453	1.024
9:35:22 AM	0	16.2042	2.1521	9:40:22	0	16.232	2.0417	9:46:37	0	16.2406	0.9078	9:52:22	0	16.2444	0.9092	9:56:22	0	16.2453	1.024
9:35:22 AM	500	16.2038	2.145	9:40:22	500	16.2328	2.0396	9:46:37	500	16.2407	0.9077	9:52:22	500	16.2442	0.9094	9:56:22	500	16.245	1.0237
9:35:23 AM	0	16.2034	2.1392	9:40:23	0	16.2333	2.0377	9:46:38	0	16.241	0.9078	9:52:23	0	16.2443	0.9093	9:56:23	0	16.2452	1.0236
9:35:23 AM	500	16.2028	2.1332	9:40:23	500	16.2335	2.0356	9:46:38	500	16.2409	0.9076	9:52:23	500	16.2443	0.9091	9:56:23	500	16.2452	1.0233
9:35:24 AM	0	16.1958	2.1243	9:40:24	0	16.2336	2.0332	9:46:39	0	16.2406	0.9076	9:52:24	0	16.2446	0.9094	9:56:24	0	16.2454	1.0231
9:35:24 AM	500	16.1664	2.115	9:40:24	500	16.2338	2.0312	9:46:39	500	16.2408	0.9076	9:52:24	500	16.2443	0.9092	9:56:24	500	16.2455	1.0229
9:35:25 AM	0	16.1775	2.0652	9:40:25	0	16.2341	2.0293	9:46:40	0	16.2412	0.908	9:52:25	0	16.2442	0.9094	9:56:25	0	16.2452	1.0227
9:35:25 AM	500	16.2074	2.0521	9:40:25	500	16.2342	2.0279	9:46:40	500	16.2409	0.9078	9:52:25	500	16.2448	0.9091	9:56:25	500	16.2454	1.0228
9:35:26 AM	0	16.2319	2.0858	9:40:26	0	16.2344	2.0262	9:46:41	0	16.2408	0.9078	9:52:26	0	16.2442	0.9089	9:56:26	0	16.2453	1.0229
9:35:26 AM	500	16.2466	2.1114	9:40:26	500	16.2342	2.0244	9:46:41	500	16.2408	0.908	9:52:26	500	16.2447	0.9091	9:56:26	500	16.2456	1.0223
9:35:27 AM	0	16.2587	2.1236	9:40:27	0	16.2343	2.0224	9:46:42	0	16.2407	0.9078	9:52:27	0	16.2445	0.9091	9:56:27	0	16.2454	1.0223
9:35:27 AM	500	16.267	2.1313	9:40:27	500	16.2345	2.0209	9:46:42	500	16.2408	0.9078	9:52:27	500	16.2442	0.9089	9:56:27	500	16.2457	1.0223
9:35:28 AM	0	16.2716	2.1366	9:40:28	0	16.2349	2.0198	9:46:43	0	16.2407	0.9079	9:52:28	0	16.2443	0.9092	9:56:28	0	16.2456	1.0222
9:35:28 AM	500	16.2729	2.1394	9:40:28	500	16.2355	2.0181	9:46:43	500	16.2409	0.9079	9:52:28	500	16.2445	0.9088	9:56:28	500	16.2455	1.0221
9:35:29 AM	0	16.2712	2.1412	9:40:29	0	16.2359	2.0167	9:46:44	0	16.2405	0.9077	9:52:29	0	16.2445	0.9088	9:56:29	0	16.2459	1.0222
9:35:29 AM	500	16.2688	2.141	9:40:29	500	16.2364	2.0164	9:46:44	500	16.241	0.9081	9:52:29	500	16.2445	0.9089	9:56:29	500	16.2461	1.0219

9:35:30 AM	0	16.2645	2.1405	9:40:30	0	16.2364	2.0157	9:46:45	0	16.2406	0.9079	9:52:30	0	16.2446	0.9091	9:56:30	0	16.2456	1.0227
9:35:30 AM	500	16.2583	2.1401	9:40:30	500	16.2361	2.0145	9:46:45	500	16.2408	0.9076	9:52:30	500	16.2443	0.9091	9:56:30	500	16.2456	1.022
9:35:31 AM	0	16.2483	2.1382	9:40:31	0	16.2359	2.0133	9:46:46	0	16.2407	0.908	9:52:31	0	16.2444	0.9089	9:56:31	0	16.245	1.0218
9:35:31 AM	500	16.2405	2.13	9:40:31	500	16.2347	2.0109	9:46:46	500	16.2409	0.9076	9:52:31	500	16.2445	0.9088	9:56:31	500	16.2447	1.0214
9:35:32 AM	0	16.2354	2.1238	9:40:32	0	16.2356	2.0089	9:46:47	0	16.2407	0.9081	9:52:32	0	16.2441	0.9088	9:56:32	0	16.2448	1.0203
9:35:32 AM	500	16.2315	2.1201	9:40:32	500	16.2365	2.0079	9:46:47	500	16.241	0.908	9:52:32	500	16.2445	0.9089	9:56:32	500	16.2448	1.0206
9:35:33 AM	0	16.2296	2.1185	9:40:33	0	16.2371	2.0086	9:46:48	0	16.2406	0.908	9:52:33	0	16.2442	0.9089	9:56:33	0	16.245	1.0203
9:35:33 AM	500	16.2294	2.1181	9:40:33	500	16.2374	2.0082	9:46:48	500	16.2408	0.9075	9:52:33	500	16.2446	0.9087	9:56:33	500	16.2449	1.0201
9:35:34 AM	0	16.2289	2.1178	9:40:34	0	16.2379	2.0074	9:46:49	0	16.2407	0.9078	9:52:34	0	16.2443	0.9087	9:56:34	0	16.2451	1.0199
9:35:34 AM	500	16.226	2.1179	9:40:34	500	16.2382	2.0074	9:46:49	500	16.2408	0.9077	9:52:34	500	16.2447	0.9088	9:56:34	500	16.245	1.0201
9:35:35 AM	0	16.2225	2.1147	9:40:35	0	16.238	2.0065	9:46:50	0	16.2406	0.9076	9:52:35	0	16.2445	0.9087	9:56:35	0	16.245	1.0201
9:35:35 AM	500	16.2205	2.1074	9:40:35	500	16.2392	2.0056	9:46:50	500	16.2408	0.9075	9:52:35	500	16.2446	0.9086	9:56:35	500	16.2451	1.0195
9:35:36 AM	0	16.2194	2.1017	9:40:36	0	16.2408	2.0058	9:46:51	0	16.2404	0.9078	9:52:36	0	16.2444	0.9088	9:56:36	0	16.2452	1.0192
9:35:36 AM	500	16.2191	2.0975	9:40:36	500	16.2415	2.0069	9:46:51	500	16.2408	0.9077	9:52:36	500	16.2444	0.9088	9:56:36	500	16.2451	1.0189
9:35:37 AM	0	16.2201	2.0945	9:40:37	0	16.2418	2.0073	9:46:52	0	16.2406	0.9077	9:52:37	0	16.2445	0.9088	9:56:37	0	16.245	1.0188
9:35:37 AM	500	16.2216	2.0912	9:40:37	500	16.2419	2.0079	9:46:52	500	16.2406	0.9078	9:52:37	500	16.2445	0.9085	9:56:37	500	16.2451	1.0191
9:35:38 AM	0	16.2228	2.0887	9:40:38	0	16.2415	2.0076	9:46:53	0	16.241	0.9078	9:52:38	0	16.2442	0.9088	9:56:38	0	16.2452	1.0189
9:35:38 AM	500	16.2245	2.0861	9:40:38	500	16.2427	2.007	9:46:53	500	16.2405	0.9078	9:52:38	500	16.2445	0.9088	9:56:38	500	16.2453	1.0189
9:35:39 AM	0	16.2258	2.0833	9:40:39	0	16.244	2.0076	9:46:54	0	16.2407	0.9076	9:52:39	0	16.2444	0.9088	9:56:39	0	16.2455	1.0188
9:35:39 AM	500	16.2272	2.081	9:40:39	500	16.2458	2.0113	9:46:54	500	16.2407	0.9078	9:52:39	500	16.2445	0.9089	9:56:39	500	16.2456	1.0185
9:35:40 AM	0	16.2285	2.0782	9:40:40	0	16.2476	2.013	9:46:55	0	16.2405	0.9078	9:52:40	0	16.2444	0.9088	9:56:40	0	16.2454	1.0183
9:35:40 AM	500	16.2293	2.0759	9:40:40	500	16.2503	2.0142	9:46:55	500	16.2408	0.9078	9:52:40	500	16.2445	0.9085	9:56:40	500	16.2455	1.0184
9:35:41 AM	0	16.2299	2.0733	9:40:41	0	16.2519	2.0198	9:46:56	0	16.2408	0.9079	9:52:41	0	16.2444	0.9088	9:56:41	0	16.2454	1.0183
9:35:41 AM	500	16.2307	2.0706	9:40:41	500	16.2525	2.0235	9:46:56	500	16.2406	0.9079	9:52:41	500	16.2443	0.9084	9:56:41	500	16.2454	1.0179

9:35:42 AM	0	16.231	2.0678	9:40:42	0	16.2521	2.026	9:46:57	0	16.2406	0.9077	9:52:42	0	16.2442	0.9086	9:56:42	0	16.2455	1.0179
9:35:42 AM	500	16.2312	2.0652	9:40:42	500	16.2513	2.0275	9:46:57	500	16.2403	0.9078	9:52:42	500	16.2442	0.9086	9:56:42	500	16.2454	1.0178
9:35:43 AM	0	16.2316	2.063	9:40:43	0	16.2498	2.0283	9:46:58	0	16.2408	0.9078	9:52:43	0	16.2442	0.9086	9:56:43	0	16.2453	1.0176
9:35:43 AM	500	16.2314	2.06	9:40:43	500	16.2489	2.0286	9:46:58	500	16.2407	0.9078	9:52:43	500	16.2445	0.9084	9:56:43	500	16.2456	1.0175
9:35:44 AM	0	16.2316	2.0576	9:40:44	0	16.2474	2.0289	9:46:59	0	16.2407	0.9075	9:52:44	0	16.2444	0.9086	9:56:44	0	16.2456	1.0176
9:35:44 AM	500	16.2318	2.0552	9:40:44	500	16.2461	2.0298	9:46:59	500	16.2405	0.9078	9:52:44	500	16.2446	0.9087	9:56:44	500	16.2453	1.0172
9:35:45 AM	0	16.2322	2.0531	9:40:45	0	16.245	2.0306	9:47:00	0	16.2408	0.9079	9:52:45	0	16.2443	0.9084	9:56:45	0	16.2456	1.017
9:35:45 AM	500	16.2323	2.0508	9:40:45	500	16.2445	2.0317	9:47:00	500	16.2407	0.9078	9:52:45	500	16.2441	0.9086	9:56:45	500	16.2455	1.0171
9:35:46 AM	0	16.2325	2.0488	9:40:46	0	16.2438	2.0322	9:47:01	0	16.2406	0.9077	9:52:46	0	16.2445	0.9087	9:56:46	0	16.2455	1.017
9:35:46 AM	500	16.2326	2.0465	9:40:46	500	16.2427	2.0327	9:47:01	500	16.2408	0.9078	9:52:46	500	16.2444	0.9086	9:56:46	500	16.2454	1.0171
9:35:47 AM	0	16.2326	2.0449	9:40:47	0	16.2425	2.0335	9:47:02	0	16.2408	0.9076	9:52:47	0	16.2445	0.9084	9:56:47	0	16.2454	1.0169
9:35:47 AM	500	16.2332	2.0431	9:40:47	500	16.2425	2.0344	9:47:02	500	16.2405	0.9076	9:52:47	500	16.2445	0.9087	9:56:47	500	16.2457	1.0168
9:35:48 AM	0	16.2333	2.0413	9:40:48	0	16.2422	2.035	9:47:03	0	16.2406	0.9078	9:52:48	0	16.2445	0.9083	9:56:48	0	16.2455	1.0167
9:35:48 AM	500	16.2336	2.0398	9:40:48	500	16.2416	2.0359	9:47:03	500	16.2408	0.9078	9:52:48	500	16.2445	0.9085	9:56:48	500	16.2456	1.0168
9:35:49 AM	0	16.2337	2.0379	9:40:49	0	16.2382	2.0367	9:47:04	0	16.2406	0.9078	9:52:49	0	16.2443	0.9084	9:56:49	0	16.2457	1.0162
9:35:49 AM	500	16.2336	2.0362	9:40:49	500	16.2351	2.0327	9:47:04	500	16.2406	0.9077	9:52:49	500	16.2448	0.9084	9:56:49	500	16.2456	1.0164
9:35:50 AM	0	16.2334	2.0339	9:40:50	0	16.2334	2.029	9:47:05	0	16.2408	0.9076	9:52:50	0	16.2443	0.9084	9:56:50	0	16.2455	1.0164
9:35:50 AM	500	16.2334	2.0324	9:40:50	500	16.2325	2.0264	9:47:05	500	16.2406	0.9079	9:52:50	500	16.2443	0.9086	9:56:50	500	16.2455	1.0162
9:35:51 AM	0	16.2335	2.0305	9:40:51	0	16.2323	2.0247	9:47:06	0	16.2407	0.9076	9:52:51	0	16.2444	0.9082	9:56:51	0	16.2455	1.0161
9:35:51 AM	500	16.2341	2.029	9:40:51	500	16.2324	2.0236	9:47:06	500	16.2408	0.9077	9:52:51	500	16.2444	0.9083	9:56:51	500	16.2454	1.0159
9:35:52 AM	0	16.2341	2.0278	9:40:52	0	16.233	2.0229	9:47:07	0	16.2406	0.9077	9:52:52	0	16.2445	0.9081	9:56:52	0	16.2452	1.0162
9:35:52 AM	500	16.2342	2.0265	9:40:52	500	16.234	2.0225	9:47:07	500	16.2405	0.9078	9:52:52	500	16.2443	0.9083	9:56:52	500	16.2455	1.0157
9:35:53 AM	0	16.2348	2.025	9:40:53	0	16.2348	2.0221	9:47:08	0	16.2405	0.9077	9:52:53	0	16.2444	0.9082	9:56:53	0	16.2455	1.0156
9:35:53 AM	500	16.235	2.0233	9:40:53	500	16.2358	2.0219	9:47:08	500	16.2408	0.9076	9:52:53	500	16.2445	0.9083	9:56:53	500	16.2458	1.0155

9:35:54 AM	0	16.2349	2.0226	9:40:54	0	16.237	2.0219	9:47:09	0	16.2406	0.9076	9:52:54	0	16.2443	0.9082	9:56:54	0	16.2455	1.0154
9:35:54 AM	500	16.2352	2.0209	9:40:54	500	16.2375	2.0215	9:47:09	500	16.2405	0.9078	9:52:54	500	16.2444	0.9083	9:56:54	500	16.2456	1.0155
9:35:55 AM	0	16.2352	2.0199	9:40:55	0	16.238	2.0212	9:47:10	0	16.2409	0.9075	9:52:55	0	16.2444	0.9081	9:56:55	0	16.2453	1.0155
9:35:55 AM	500	16.2354	2.0187	9:40:55	500	16.2384	2.0203	9:47:10	500	16.2407	0.9077	9:52:55	500	16.2446	0.9086	9:56:55	500	16.2456	1.0152
9:35:56 AM	0	16.2356	2.0173	9:40:56	0	16.2385	2.02	9:47:11	0	16.2411	0.9077	9:52:56	0	16.2444	0.9084	9:56:56	0	16.2457	1.0152
9:35:56 AM	500	16.2353	2.0159	9:40:56	500	16.2385	2.019	9:47:11	500	16.2406	0.9077	9:52:56	500	16.2442	0.9084	9:56:56	500	16.2457	1.0149
9:35:57 AM	0	16.2353	2.0145	9:40:57	0	16.2386	2.0181	9:47:12	0	16.2407	0.9076	9:52:57	0	16.2442	0.9086	9:56:57	0	16.2456	1.0152
9:35:57 AM	500	16.2344	2.013	9:40:57	500	16.2393	2.0176	9:47:12	500	16.2407	0.9075	9:52:57	500	16.2446	0.9086	9:56:57	500	16.2454	1.0149
9:35:58 AM	0	16.2341	2.0109	9:40:58	0	16.2394	2.0174	9:47:13	0	16.2408	0.9075	9:52:58	0	16.2443	0.9082	9:56:58	0	16.246	1.015
9:35:58 AM	500	16.2337	2.0092	9:40:58	500	16.2396	2.0173	9:47:13	500	16.2407	0.908	9:52:58	500	16.2444	0.9083	9:56:58	500	16.2456	1.0149
9:35:59 AM	0	16.2339	2.0076	9:40:59	0	16.2389	2.0168	9:47:14	0	16.2406	0.9076	9:52:59	0	16.2447	0.9085	9:56:59	0	16.2456	1.0146
9:35:59 AM	500	16.2342	2.0058	9:40:59	500	16.2382	2.0155	9:47:14	500	16.2407	0.9076	9:52:59	500	16.2445	0.9081	9:56:59	500	16.2455	1.0148
9:36:00 AM	0	16.2344	2.0051	9:41:00	0	16.2379	2.0148	9:47:15	0	16.2407	0.9076	9:53:00	0	16.2442	0.9082	9:57:00	0	16.2458	1.0145
9:36:00 AM	500	16.2355	2.0044	9:41:00	500	16.2375	2.0134	9:47:15	500	16.2408	0.9078	9:53:00	500	16.2444	0.9086	9:57:00	500	16.2456	1.0146
9:36:01 AM	0	16.2361	2.0034	9:41:01	0	16.2373	2.0126	9:47:16	0	16.2407	0.9079	9:53:01	0	16.2446	0.908	9:57:01	0	16.2458	1.0145
9:36:01 AM	500	16.2367	2.003	9:41:01	500	16.2375	2.0117	9:47:16	500	16.2409	0.9075	9:53:01	500	16.2445	0.908	9:57:01	500	16.2456	1.0142
9:36:02 AM	0	16.2367	2.0024	9:41:02	0	16.2381	2.0112	9:47:17	0	16.2403	0.9076	9:53:02	0	16.2444	0.9085	9:57:02	0	16.2456	1.0141
9:36:02 AM	500	16.2369	2.0016	9:41:02	500	16.2377	2.0109	9:47:17	500	16.2406	0.9075	9:53:02	500	16.2445	0.9084	9:57:02	500	16.2454	1.0139
9:36:03 AM	0	16.2369	2.0008	9:41:03	0	16.238	2.0101	9:47:18	0	16.2404	0.9077	9:53:03	0	16.2443	0.9081	9:57:03	0	16.2454	1.014
9:36:03 AM	500	16.237	1.9998	9:41:03	500	16.2387	2.0099	9:47:18	500	16.2408	0.9076	9:53:03	500	16.2444	0.9083	9:57:03	500	16.2452	1.0137
9:36:04 AM	0	16.2367	1.9988	9:41:04	0	16.2391	2.01	9:47:19	0	16.2405	0.9076	9:53:04	0	16.2446	0.9082	9:57:04	0	16.2454	1.0135
9:36:04 AM	500	16.2368	1.998	9:41:04	500	16.2397	2.0104	9:47:19	500	16.2406	0.9079	9:53:04	500	16.2445	0.9081	9:57:04	500	16.2452	1.0136
9:36:05 AM	0	16.2372	1.9971	9:41:05	0	16.24	2.0102	9:47:20	0	16.2404	0.9077	9:53:05	0	16.2443	0.908	9:57:05	0	16.2451	1.0135
9:36:05 AM	500	16.2368	1.9961	9:41:05	500	16.2397	2.01	9:47:20	500	16.2406	0.9076	9:53:05	500	16.2443	0.9083	9:57:05	500	16.2452	1.0133

9:36:06 AM	0	16.2371	1.995	9:41:06	0	16.2394	2.0098	9:47:21	0	16.2407	0.9077	9:53:06	0	16.2444	0.9083	9:57:06	0	16.2452	1.0134
9:36:06 AM	500	16.2368	1.9941	9:41:06	500	16.2389	2.0089	9:47:21	500	16.2409	0.9075	9:53:06	500	16.2446	0.9083	9:57:06	500	16.2453	1.0132
9:36:07 AM	0	16.2364	1.9933	9:41:07	0	16.2396	2.0086	9:47:22	0	16.2408	0.9076	9:53:07	0	16.2443	0.9081	9:57:07	0	16.2455	1.0127
9:36:07 AM	500	16.2362	1.9924	9:41:07	500	16.2391	2.0078	9:47:22	500	16.2408	0.9077	9:53:07	500	16.2442	0.908	9:57:07	500	16.2451	1.0125
9:36:08 AM	0	16.2364	1.9916	9:41:08	0	16.2391	2.0078	9:47:23	0	16.2408	0.9075	9:53:08	0	16.2445	0.9083	9:57:08	0	16.2455	1.0128
9:36:08 AM	500	16.2364	1.9904	9:41:08	500	16.2394	2.0074	9:47:23	500	16.2407	0.9077	9:53:08	500	16.2443	0.9083	9:57:08	500	16.2457	1.0127
9:36:09 AM	0	16.2366	1.9897	9:41:09	0	16.239	2.0069	9:47:24	0	16.2409	0.9076	9:53:09	0	16.2441	0.908	9:57:09	0	16.2457	1.0125
9:36:09 AM	500	16.2365	1.9892	9:41:09	500	16.2391	2.0066	9:47:24	500	16.2407	0.9076	9:53:09	500	16.2441	0.9078	9:57:09	500	16.2455	1.0126
9:36:10 AM	0	16.2367	1.9883	9:41:10	0	16.2391	2.0064	9:47:25	0	16.2406	0.9075	9:53:10	0	16.2446	0.9083	9:57:10	0	16.2456	1.0123
9:36:10 AM	500	16.2367	1.9875	9:41:10	500	16.2388	2.0058	9:47:25	500	16.2406	0.9077	9:53:10	500	16.2442	0.908	9:57:10	500	16.2459	1.0122
9:36:11 AM	0	16.2369	1.9868	9:41:11	0	16.2398	2.0059	9:47:26	0	16.2409	0.9077	9:53:11	0	16.2444	0.9081	9:57:11	0	16.2462	1.0124
9:36:11 AM	500	16.2377	1.9861	9:41:11	500	16.2395	2.0056	9:47:26	500	16.2407	0.9075	9:53:11	500	16.2441	0.9078	9:57:11	500	16.2483	1.0133
9:36:12 AM	0	16.2373	1.9855	9:41:12	0	16.2393	2.0052	9:47:27	0	16.2408	0.9077	9:53:12	0	16.2445	0.908	9:57:12	0	16.2481	1.0155
9:36:12 AM	500	16.2375	1.9852	9:41:12	500	16.2396	2.0053	9:47:27	500	16.2408	0.9077	9:53:12	500	16.2442	0.9077	9:57:12	500	16.2481	1.0163
9:36:13 AM	0	16.2375	1.9848	9:41:13	0	16.2398	2.0048	9:47:28	0	16.2406	0.9077	9:53:13	0	16.2443	0.908	9:57:13	0	16.2472	1.0155
9:36:13 AM	500	16.2378	1.9842	9:41:13	500	16.2397	2.0052	9:47:28	500	16.2408	0.9076	9:53:13	500	16.2443	0.908	9:57:13	500	16.2476	1.0147
9:36:14 AM	0	16.2378	1.9834	9:41:14	0	16.2394	2.0048	9:47:29	0	16.2409	0.9077	9:53:14	0	16.2441	0.9081	9:57:14	0	16.2477	1.0152
9:36:14 AM	500	16.2377	1.9827	9:41:14	500	16.2398	2.0045	9:47:29	500	16.2408	0.9078	9:53:14	500	16.2443	0.9081	9:57:14	500	16.247	1.0162
9:36:15 AM	0	16.2372	1.9816	9:41:15	0	16.2393	2.0044	9:47:30	0	16.2407	0.9077	9:53:15	0	16.2443	0.9077	9:57:15	0	16.247	1.0162
9:36:15 AM	500	16.2371	1.981	9:41:15	500	16.2399	2.004	9:47:30	500	16.2409	0.9075	9:53:15	500	16.2442	0.9079	9:57:15	500	16.2464	1.0159
9:36:16 AM	0	16.2371	1.9802	9:41:16	0	16.2396	2.0034	9:47:31	0	16.241	0.9079	9:53:16	0	16.2445	0.908	9:57:16	0	16.2455	1.0152
9:36:16 AM	500	16.237	1.9794	9:41:16	500	16.2399	2.0034	9:47:31	500	16.2409	0.9076	9:53:16	500	16.2442	0.9082	9:57:16	500	16.2455	1.015
9:36:17 AM	0	16.2368	1.9785	9:41:17	0	16.2397	2.0033	9:47:32	0	16.241	0.9074	9:53:17	0	16.2446	0.9079	9:57:17	0	16.2452	1.0146
9:36:17 AM	500	16.2369	1.978	9:41:17	500	16.2394	2.003	9:47:32	500	16.2408	0.9077	9:53:17	500	16.2443	0.908	9:57:17	500	16.2447	1.0142

9:36:18 AM	0	16.2376	1.9777	9:41:18	0	16.2387	2.0026	9:47:33	0	16.2408	0.9077	9:53:18	0	16.2445	0.9079	9:57:18	0	16.2446	1.0138
9:36:18 AM	500	16.2368	1.9767	9:41:18	500	16.2385	2.0016	9:47:33	500	16.2407	0.9075	9:53:18	500	16.2447	0.908	9:57:18	500	16.2444	1.0137
9:36:19 AM	0	16.2374	1.9765	9:41:19	0	16.2388	2.0011	9:47:34	0	16.2406	0.9078	9:53:19	0	16.2447	0.9082	9:57:19	0	16.2447	1.0133
9:36:19 AM	500	16.2374	1.976	9:41:19	500	16.239	2.001	9:47:34	500	16.2408	0.9076	9:53:19	500	16.2444	0.9079	9:57:19	500	16.2446	1.0131
9:36:20 AM	0	16.2375	1.9751	9:41:20	0	16.2389	2.0009	9:47:35	0	16.2405	0.9078	9:53:20	0	16.2445	0.9081	9:57:20	0	16.2445	1.0133
9:36:20 AM	500	16.2375	1.9745	9:41:20	500	16.2392	2.0006	9:47:35	500	16.241	0.9078	9:53:20	500	16.2443	0.9083	9:57:20	500	16.2447	1.0132
9:36:21 AM	0	16.2377	1.9737	9:41:21	0	16.2393	2.0003	9:47:36	0	16.2407	0.9077	9:53:21	0	16.2446	0.9082	9:57:21	0	16.2453	1.0129
9:36:21 AM	500	16.2377	1.9735	9:41:21	500	16.2395	2.0003	9:47:36	500	16.2407	0.9079	9:53:21	500	16.2443	0.9078	9:57:21	500	16.2452	1.0131
9:36:22 AM	0	16.2375	1.9727	9:41:22	0	16.2393	2.0001	9:47:37	0	16.2406	0.9074	9:53:22	0	16.2445	0.9079	9:57:22	0	16.2454	1.0134
9:36:22 AM	500	16.2376	1.972	9:41:22	500	16.2396	2.0001	9:47:37	500	16.2406	0.9075	9:53:22	500	16.2444	0.908	9:57:22	500	16.2454	1.0131
9:36:23 AM	0	16.2382	1.9718	9:41:23	0	16.2398	1.9997	9:47:38	0	16.241	0.9075	9:53:23	0	16.2443	0.9078	9:57:23	0	16.2453	1.0128
9:36:23 AM	500	16.2383	1.9714	9:41:23	500	16.2394	1.9991	9:47:38	500	16.2405	0.9074	9:53:23	500	16.2443	0.908	9:57:23	500	16.2456	1.0129
9:36:24 AM	0	16.2385	1.9713	9:41:24	0	16.2399	1.999	9:47:39	0	16.2407	0.9074	9:53:24	0	16.2445	0.908	9:57:24	0	16.2455	1.0129
9:36:24 AM	500	16.2388	1.9711	9:41:24	500	16.2399	1.999	9:47:39	500	16.2408	0.9077	9:53:24	500	16.2442	0.908	9:57:24	500	16.2455	1.0126
9:36:25 AM	0	16.2391	1.9711	9:41:25	0	16.2396	1.9987	9:47:40	0	16.2408	0.9075	9:53:25	0	16.2443	0.9079	9:57:25	0	16.2455	1.0122
9:36:25 AM	500	16.2396	1.971	9:41:25	500	16.24	1.9983	9:47:40	500	16.2406	0.9075	9:53:25	500	16.2445	0.9078	9:57:25	500	16.2454	1.0121
9:36:26 AM	0	16.2397	1.971	9:41:26	0	16.2398	1.9981	9:47:41	0	16.2407	0.9077	9:53:26	0	16.2445	0.9081	9:57:26	0	16.2457	1.0121
9:36:26 AM	500	16.2396	1.971	9:41:26	500	16.2399	1.998	9:47:41	500	16.241	0.9074	9:53:26	500	16.2446	0.908	9:57:26	500	16.2455	1.0121
9:36:27 AM	0	16.2396	1.9708	9:41:27	0	16.2398	1.9979	9:47:42	0	16.2409	0.9074	9:53:27	0	16.2446	0.908	9:57:27	0	16.2454	1.0123
9:36:27 AM	500	16.2396	1.9707	9:41:27	500	16.24	1.9979	9:47:42	500	16.2408	0.9075	9:53:27	500	16.2446	0.9079	9:57:27	500	16.2461	1.0119
9:36:28 AM	0	16.2393	1.9704	9:41:28	0	16.2401	1.9977	9:47:43	0	16.2409	0.9075	9:53:28	0	16.2445	0.908	9:57:28	0	16.246	1.0116
9:36:28 AM	500	16.2392	1.9698	9:41:28	500	16.2406	1.9976	9:47:43	500	16.2407	0.9074	9:53:28	500	16.2448	0.9079	9:57:28	500	16.2459	1.0117
9:36:29 AM	0	16.2394	1.9699	9:41:29	0	14.8422	1.9978	9:47:44	0	16.2409	0.9073	9:53:29	0	16.2446	0.908	9:57:29	0	16.2462	1.0122
9:36:29 AM	500	16.2384	1.9694	9:41:29	500	15.698	1.9737	9:47:44	500	16.2408	0.9073	9:53:29	500	16.2443	0.908	9:57:29	500	16.1767	1.0122

9:36:30 AM	0	16.2254	1.9691	9:41:30	0	15.3326	0.9287	9:47:45	0	16.3665	0.9075	9:53:30	0	16.2315	0.9078	9:57:30	0	16.2303	1.0132
9:36:30 AM	500	17.1992	1.9556	9:41:30	500	15.605	0.8926	9:47:45	500	16.1846	0.9046	9:53:30	500	16.2526	0.9051	9:57:30	500	16.1469	0.9088
9:36:31 AM	0	14.893	0.8679	9:41:31	0	15.5183	0.9166	9:47:46	0	16.2703	0.9089	9:53:31	0	16.2426	0.906	9:57:31	0	16.188	0.9046
9:36:31 AM	500	15.8032	0.8964	9:41:31	500	15.6865	0.9038	9:47:46	500	16.2303	0.9076	9:53:31	500	16.2442	0.9066	9:57:31	500	16.1921	0.9053
9:36:32 AM	0	15.3983	0.917	9:41:32	0	15.7282	0.9105	9:47:47	0	16.2532	0.9074	9:53:32	0	16.2456	0.9061	9:57:32	0	16.1855	0.9068
9:36:32 AM	500	15.6831	0.9033	9:41:32	500	15.8536	0.9068	9:47:47	500	16.24	0.9077	9:53:32	500	16.2446	0.9064	9:57:32	500	16.2099	0.9055
9:36:33 AM	0	15.6515	0.9125	9:41:33	0	15.9262	0.9092	9:47:48	0	16.2472	0.9075	9:53:33	0	16.245	0.9065	9:57:33	0	16.2081	0.9064
9:36:33 AM	500	15.8063	0.9073	9:41:33	500	16.0196	0.9078	9:47:48	500	16.2434	0.9077	9:53:33	500	16.2452	0.9063	9:57:33	500	16.2231	0.906
9:36:34 AM	0	15.864	0.9101	9:41:34	0	16.0889	0.9085	9:47:49	0	16.2449	0.9075	9:53:34	0	16.2451	0.9064	9:57:34	0	16.2291	0.9058
9:36:34 AM	500	15.9675	0.9087	9:41:34	500	16.1521	0.9081	9:47:49	500	16.2443	0.9074	9:53:34	500	16.2454	0.9066	9:57:34	500	16.2371	0.9062
9:36:35 AM	0	16.0409	0.9093	9:41:35	0	16.2038	0.9082	9:47:50	0	16.2446	0.9077	9:53:35	0	16.2452	0.9063	9:57:35	0	16.2436	0.9059
9:36:35 AM	500	16.1096	0.9093	9:41:35	500	16.2431	0.9085	9:47:50	500	16.2442	0.9078	9:53:35	500	16.2455	0.9062	9:57:35	500	16.2488	0.906
9:36:36 AM	0	16.169	0.909	9:41:36	0	16.2739	0.9082	9:47:51	0	16.2447	0.9076	9:53:36	0	16.2456	0.9063	9:57:36	0	16.2526	0.9061
9:36:36 AM	500	16.2151	0.9093	9:41:36	500	16.2951	0.9083	9:47:51	500	16.2446	0.9074	9:53:36	500	16.2455	0.9064	9:57:36	500	16.2555	0.9063
9:36:37 AM	0	16.2522	0.9091	9:41:37	0	16.3086	0.9083	9:47:52	0	16.2445	0.9076	9:53:37	0	16.2459	0.9064	9:57:37	0	16.2573	0.9059
9:36:37 AM	500	16.2795	0.9089	9:41:37	500	16.3157	0.9086	9:47:52	500	16.2444	0.9076	9:53:37	500	16.2454	0.9065	9:57:37	500	16.2587	0.906
9:36:38 AM	0	16.2979	0.909	9:41:38	0	16.3176	0.9082	9:47:53	0	16.2445	0.9076	9:53:38	0	16.246	0.9066	9:57:38	0	16.2588	0.9061
9:36:38 AM	500	16.3093	0.909	9:41:38	500	16.3154	0.9082	9:47:53	500	16.2447	0.9074	9:53:38	500	16.2456	0.9063	9:57:38	500	16.2582	0.9061
9:36:39 AM	0	16.3147	0.9091	9:41:39	0	16.31	0.9084	9:47:54	0	16.2446	0.9075	9:53:39	0	16.2456	0.9064	9:57:39	0	16.2578	0.9066
9:36:39 AM	500	16.3151	0.9095	9:41:39	500	16.3025	0.9083	9:47:54	500	16.2445	0.9077	9:53:39	500	16.2456	0.9065	9:57:39	500	16.2569	0.9062
9:36:40 AM	0	16.3117	0.9091	9:41:40	0	16.2933	0.9084	9:47:55	0	16.2446	0.9075	9:53:40	0	16.2454	0.9065	9:57:40	0	16.2553	0.906
9:36:40 AM	500	16.3062	0.9092	9:41:40	500	16.284	0.9084	9:47:55	500	16.2443	0.9075	9:53:40	500	16.2456	0.9065	9:57:40	500	16.2541	0.9061
9:36:41 AM	0	16.2977	0.9092	9:41:41	0	16.2742	0.9082	9:47:56	0	16.2444	0.9074	9:53:41	0	16.2456	0.9066	9:57:41	0	16.2529	0.906
9:36:41 AM	500	16.2888	0.9091	9:41:41	500	16.2655	0.9081	9:47:56	500	16.2444	0.9075	9:53:41	500	16.2456	0.9065	9:57:41	500	16.2518	0.9061

9:36:42 AM	0	16.2798	0.9092	9:41:42	0	16.2571	0.9083	9:47:57	0	16.2443	0.9077	9:53:42	0	16.2455	0.9062	9:57:42	0	16.2508	0.906
9:36:42 AM	500	16.2705	0.9092	9:41:42	500	16.25	0.9082	9:47:57	500	16.2446	0.9077	9:53:42	500	16.2452	0.9063	9:57:42	500	16.2497	0.906
9:36:43 AM	0	16.2617	0.9091	9:41:43	0	16.2442	0.9085	9:47:58	0	16.2445	0.9077	9:53:43	0	16.2455	0.9064	9:57:43	0	16.249	0.9061
9:36:43 AM	500	16.254	0.9093	9:41:43	500	16.2391	0.9083	9:47:58	500	16.2444	0.9075	9:53:43	500	16.2456	0.9066	9:57:43	500	16.248	0.9061
9:36:44 AM	0	16.2472	0.9091	9:41:44	0	16.2356	0.9086	9:47:59	0	16.2446	0.9076	9:53:44	0	16.2455	0.9062	9:57:44	0	16.2479	0.9062
9:36:44 AM	500	16.2417	0.909	9:41:44	500	16.2326	0.9083	9:47:59	500	16.2444	0.9075	9:53:44	500	16.2453	0.9067	9:57:44	500	16.2475	0.906
9:36:45 AM	0	16.2375	0.9093	9:41:45	0	16.2316	0.9084	9:48:00	0	16.2443	0.9076	9:53:45	0	16.2456	0.9064	9:57:45	0	16.2473	0.9059
9:36:45 AM	500	16.2343	0.9094	9:41:45	500	16.2304	0.9084	9:48:00	500	16.2444	0.9073	9:53:45	500	16.2452	0.9062	9:57:45	500	16.2471	0.9062
9:36:46 AM	0	16.2322	0.9092	9:41:46	0	16.2304	0.9084	9:48:01	0	16.2446	0.9074	9:53:46	0	16.2455	0.9062	9:57:46	0	16.2473	0.9059
9:36:46 AM	500	16.2304	0.9092	9:41:46	500	16.2308	0.9084	9:48:01	500	16.2444	0.9076	9:53:46	500	16.2454	0.9065	9:57:46	500	16.2477	0.906
9:36:47 AM	0	16.2295	0.9092	9:41:47	0	16.2314	0.9082	9:48:02	0	16.2445	0.9075	9:53:47	0	16.2457	0.9065	9:57:47	0	16.2471	0.9061
9:36:47 AM	500	16.23	0.9091	9:41:47	500	16.2325	0.9084	9:48:02	500	16.2443	0.9073	9:53:47	500	16.2454	0.9066	9:57:47	500	16.2473	0.9057
9:36:48 AM	0	16.2305	0.9091	9:41:48	0	16.2337	0.9085	9:48:03	0	16.2444	0.9074	9:53:48	0	16.2455	0.9062	9:57:48	0	16.2478	0.906
9:36:48 AM	500	16.231	0.9092	9:41:48	500	16.2348	0.9088	9:48:03	500	16.2443	0.9075	9:53:48	500	16.2455	0.9062	9:57:48	500	16.2477	0.9061
9:36:49 AM	0	16.2319	0.9092	9:41:49	0	16.2362	0.9088	9:48:04	0	16.2448	0.9074	9:53:49	0	16.2455	0.9065	9:57:49	0	16.2481	0.9061
9:36:49 AM	500	16.2335	0.9094	9:41:49	500	16.2372	0.9084	9:48:04	500	16.2443	0.9074	9:53:49	500	16.2453	0.9062	9:57:49	500	16.2482	0.9059
9:36:50 AM	0	16.2344	0.9092	9:41:50	0	16.2385	0.9086	9:48:05	0	16.2445	0.9075	9:53:50	0	16.2454	0.9067	9:57:50	0	16.2483	0.906
9:36:50 AM	500	16.2357	0.9096	9:41:50	500	16.2392	0.9085	9:48:05	500	16.2446	0.9076	9:53:50	500	16.2454	0.9063	9:57:50	500	16.2486	0.9058
9:36:51 AM	0	16.2369	0.9093	9:41:51	0	16.2398	0.9084	9:48:06	0	16.2443	0.9077	9:53:51	0	16.2458	0.9065	9:57:51	0	16.2486	0.906
9:36:51 AM	500	16.238	0.9092	9:41:51	500	16.2405	0.9085	9:48:06	500	16.2442	0.9076	9:53:51	500	16.2457	0.9061	9:57:51	500	16.2481	0.9058
9:36:52 AM	0	16.2386	0.9093	9:41:52	0	16.2411	0.9081	9:48:07	0	16.2446	0.9078	9:53:52	0	16.2454	0.9066	9:57:52	0	16.2485	0.9061
9:36:52 AM	500	16.2392	0.909	9:41:52	500	16.2411	0.9082	9:48:07	500	16.2445	0.9076	9:53:52	500	16.2455	0.9064	9:57:52	500	16.2486	0.9061
9:36:53 AM	0	16.2395	0.9091	9:41:53	0	16.2413	0.9084	9:48:08	0	16.2444	0.9075	9:53:53	0	16.2457	0.9064	9:57:53	0	16.2485	0.906
9:36:53 AM	500	16.2402	0.9091	9:41:53	500	16.2416	0.9084	9:48:08	500	16.2444	0.9075	9:53:53	500	16.2454	0.9063	9:57:53	500	16.2485	0.906

9:36:54 AM	0	16.2402	0.9091	9:41:54	0	16.2415	0.9082	9:48:09	0	16.2448	0.9074	9:53:54	0	16.2457	0.9063	9:57:54	0	16.2485	0.9061
9:36:54 AM	500	16.2403	0.9094	9:41:54	500	16.2414	0.9085	9:48:09	500	16.2442	0.9076	9:53:54	500	16.2457	0.9065	9:57:54	500	16.2484	0.9059
9:36:55 AM	0	16.2402	0.9093	9:41:55	0	16.2409	0.9086	9:48:10	0	16.2445	0.9077	9:53:55	0	16.2456	0.9061	9:57:55	0	16.2486	0.9058
9:36:55 AM	500	16.2403	0.909	9:41:55	500	16.2407	0.9083	9:48:10	500	16.2445	0.9074	9:53:55	500	16.2454	0.9065	9:57:55	500	16.2483	0.9059
9:36:56 AM	0	16.2402	0.909	9:41:56	0	16.2408	0.9084	9:48:11	0	16.2443	0.9075	9:53:56	0	16.2452	0.9065	9:57:56	0	16.2484	0.9062
9:36:56 AM	500	16.2402	0.9094	9:41:56	500	16.2406	0.9081	9:48:11	500	16.2445	0.9076	9:53:56	500	16.2457	0.9061	9:57:56	500	16.2487	0.9061
9:36:57 AM	0	16.2401	0.9091	9:41:57	0	16.2405	0.9082	9:48:12	0	16.2444	0.9076	9:53:57	0	16.2451	0.9068	9:57:57	0	16.2481	0.906
9:36:57 AM	500	16.2397	0.9092	9:41:57	500	16.2405	0.9085	9:48:12	500	16.2447	0.9077	9:53:57	500	16.2456	0.9064	9:57:57	500	16.2486	0.9062
9:36:58 AM	0	16.2398	0.9089	9:41:58	0	16.2403	0.9083	9:48:13	0	16.2448	0.9076	9:53:58	0	16.2454	0.9061	9:57:58	0	16.2487	0.9059
9:36:58 AM	500	16.2393	0.9092	9:41:58	500	16.2401	0.9084	9:48:13	500	16.2445	0.9075	9:53:58	500	16.2454	0.9063	9:57:58	500	16.2483	0.9062
9:36:59 AM	0	16.2394	0.9091	9:41:59	0	16.24	0.9085	9:48:14	0	16.2445	0.9076	9:53:59	0	16.2453	0.9062	9:57:59	0	16.2484	0.9061
9:36:59 AM	500	16.2389	0.9092	9:41:59	500	16.24	0.9083	9:48:14	500	16.2444	0.9074	9:53:59	500	16.2455	0.9066	9:57:59	500	16.2482	0.9059
				9:42:00	0	16.24	0.9084	9:48:15	0	16.2447	0.9075	9:54:00	0	16.2454	0.9063	9:58:00	0	16.2482	0.9062
				9:42:00	500	16.24	0.9082	9:48:15	500	16.2443	0.9076	9:54:00	500	16.2456	0.9061	9:58:00	500	16.2485	0.9059

APPENDIX C: Raw Data for Push-Pull Tests

Table C1. Data for the final push-pull test conducted at well 3 in 2013.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temperature** (ºC)	**Alkalinity** (mg/L as $CaCO_3$)	**Field** Cl^- (mg/L)	**LDO** (mg/L)	**Lab** Cl^- (mg/L)	**δD** (‰)
11138	21-10-2013	8:52	1	Start of extraction	Full	6.58	4.2		6.38			
11139	21-10-2013	11:28	727	End of extraction	Full	7.31	7.1	272	6.07	1.43	8.53	-140.2
11140	21-10-2013	12:33	0	Start of spike injection	Full	7.91	7.7	275	-	-	656	-45.8
11141	21-10-2013	1:19	255	250L of spike injected	Full	7.89	8.9	278	605	10.6	666	-45.0
11142	21-10-2013	1:53	435	End of spike injection	Full	8.18	9.4	281	590	-	651	-43.9
11143	21-10-2013	2:26	100	Clean water push	Full	7.21	11.7	271	5.11			
11144	21-10-2013	12:40	55	50L of spike injected	Anions, Isotopes	7.83	9.2		590	10.6		
11145	21-10-2013	12:51	102	150L of spike injected	Anions, Isotopes				585	10.83		
11146	21-10-2013	13:30	303	300L of spike injected	Anions, Isotopes				575	10.51		
11147	21-10-2013	13:47	400	400L of spike injected	Anions, Isotopes				577	10.6		
11148	21-10-2013	13:19	255	DUP of #11141	Full	7.89	8.9	278	605	10.6	652	-43.4
11149	22-10-2013	8:15	10	Start of Extraction	Full	7.13	5.8	251	63.6	1.21	74.9	-129.2
11150	22-10-2013	8:45	138	30mins into Extraction	Full	7	4.7	230	68.3	0.8		
11151	22-10-2013	9:15	277	1hr	Full	7.13	4.9	254	57.5	0.55	57.6	-132.3
11152	22-10-2013	9:45	410	1.5hrs	Full	7.13	5.4	253	53.5	0.44		
11153	22-10-2013	10:15	547	2hrs	Full	7.2	5.4	252	51.3	0.35	46.8	-134.6
11154	22-10-2013	10:45	685	2.5hrs	Full	7.22	6	257	45.9	0.32		
11155	22-10-2013	11:15	823	3hrs	Full	7.33	6.2	257	45.5	0.26	38.3	-135.9
11156	22-10-2013	11:45	956	3.5hrs	Full	7.31	6.3	267	39.2	0.22		
11157	22-10-2013	12:15	1093	4hrs	Full	7.32	6.3	259	41.1	0.18	32.8	-137.1

11158	22-10-2013	13:15	1354	5hrs	Full	7.33	8.3	262	33.2	0.14	28.1	-139.2
11159	22-10-2013	14:15	1624	6hrs	Full	7.21	8.3	258	27.7	0.12	24.4	-139.4
11160	22-10-2013	15:15	1894	7hrs	Full	7.16	7.9	244	23.9	0.08	22.1	-139.7
11161	22-10-2013	15:50	2038	8hrs	Full	7.27	10.2	233	21.3	0.08	21.1	-139.7
11162	22-10-2013	8:30	65	15mins	Anions, Isotopes				70.3	1.03		
11163	22-10-2013	8:30	65	DUP of #11162	Anions, Isotopes				70.3	1.03		
11164	22-10-2013	9:00	208	45mins	Anions, Isotopes				61	0.68		
11165	22-10-2013	9:30	345	1hr 15mins	Anions, Isotopes				54.6	0.49		
11166	22-10-2013	10:00	477	1hr 45mins	Anions, Isotopes				50	0.38		
11167	22-10-2013	10:30	615	2hr 15 mins	Anions, Isotopes				47.7	0.33		
11168	22-10-2013	10:40		BLANK	Full					0.31	0.0792	-142.3
11169	22-10-2013	11:00	750	2hr 45mins	Anions, Isotopes				44.6	0.29		
11170	22-10-2013	11:30	887	3hr 15mins	Anions, Isotopes				44	0.23		
11171	22-10-2013	12:00	1017	3hr 45mins	Anions, Isotopes				39.7	0.2		
11172	22-10-2013	12:45	1216	4.5hrs	Anions, Isotopes				34.3	0.17		
11173	22-10-2013	13:45	1487	5.5hrs	Anions, Isotopes				29.1	0.11		
11174	22-10-2013	14:45	1756	6.5hrs	Anions, Isotopes				24.9	0.09		
11175	22-10-2013	15:45	2015	7.5hrs	Anions, Isotopes				21.7	0.07		
11176	22-10-2013	15:45	2015	DUP of #11175	Anions, Isotopes				21.7	0.07		
11177	23-10-2013	7:40	6155	Start of Day 2 Extraction	Full	6.91	5.3	230	11.1	0.09	11.1	-140.7
11178	23-10-2013	7:40	6155	DUP of #11177	Full	6.91	5.3	230	11.1	0.09	10.9	-140.6
11179	23-10-2013	8:30	6420	After increased flow (6.8)	Full	7.03	4.9	248	11.6	0.06		
11180	23-10-2013	9:20	6708	After decreased flow (4.6)	Full	6.99	4.8	228	11.3	0.08	11.5	-140.5

11181	23-10-2013	10:40	6960	Flow at 3L/min	Full	7.12	5.6	237	10.8	0.08		
11182	23-10-2013	12:40	7626		Full	7.23	7.3	230	10.9	0.1	10.3	-138.7
11183	23-10-2013	8:10	6293		Anions, Isotopes				11.2	0.06		
11184	23-10-2013	8:50	6558	After increased flow (6.8)	Anions, Isotopes				11.5	0.07		
11185	23-10-2013	10:00	6837	After decreased flow (3L/min)	Anions, Isotopes				10.2	0.09		
11186	23-10-2013	11:40	7350	Flow at 6.8L/min	Anions, Isotopes				12.1	0.1		
11187	23-10-2013	14:40	8611	Flow at 11L/min	Full	7.21	8	236	10.5	0.1		
11188	23-10-2013	12:40	7626	DUP of #11182	Full	7.23	7.3	230	10.9	0.1		
11189	23-10-2013	16:15	8950		Full	7.16	10.1	219	6.44	0.11		
11190	23-10-2013	11:50		Henretta Creek	Full	7.99	6.8		0.707		0.68	-138.4
	23-10-2013	9:12	6667	extra cl reading					11.5	0.08		
	23-10-2013	9:40	6779	extra cl reading					10.7	0.08		
	23-10-2013	10:22	6906	extra cl reading					9.86	0.08		
	23-10-2013	11:12	7156	extra cl reading					12.4	0.07		
	23-10-2013	12:07	7492	extra cl reading					9.77	0.1		
	23-10-2013	12:23	7564	extra cl reading					11.8	0.1		
	23-10-2013	13:19	7748	extra cl reading					10.7	0.1		
	23-10-2013	14:05	8229	extra cl reading					10	0.1		
	23-10-2013	14:23	8434	extra cl reading					9.11	0.1		
	23-10-2013	15:05	8735	extra cl reading					8.29	0.12		
	23-10-2013	15:35	8859	extra cl reading					7.1	0.12		
	23-10-2013	15:57	8896	extra cl reading					6.75	0.11		
	23-10-2013	16:05	8922	extra cl reading					6.26	0.11		

	23-10-2013	16:25	8977	extra cl reading					5.95	0.11		
	23-10-2013	16:35	9004	extra cl reading					6.26	0		
11191	23-10-2013	13:40	7945		Anions, Isotopes				10.5	0.09		
11192	23-10-2013	15:30	8808		Anions, Isotopes				6.65	0.12		
11193	23-10-2013			Sample from night pumping tote	Full						18.2	
11194	23-10-2013	16:45	9039	Sample from END OF EXRACTION	Full				5.95	0	9.05	

Table C2. Raw data for push-pull test 1 conducted at well 3 in 2014.

Sample ID	Date	Time	Volume (L)	Description	Analysis Type	pH	Temperature (ºC)	Alkalinity (mg/L as $CaCO_3$)	Cl^- (mg/L)	LDO (mg/L)	Lab Se (mg/L)	Lab Cl^- (mg/L)	Lab δD (‰)
11220	13-Jun	8:38	1	End of Purge/Start of Extraction	Full	7.49	6.1	191	0.619	NA	0.0455	1.24	-148.2
11221	13-Jun	10:07	1230	End of Extraction	Full	7.45	7.8	180	0.727	0.6	0.0607	1.45	-148.4
11207	13-Jun	10:40	10	Start of Spike Injection	Full	7.59	8.2	186	1040	0.56	1.09	959	-60.9
11208	13-Jun	10:40	10	DUP of 11207	Full						1.07	964	-48.2
11209	13-Jun	10:45	50	50L injected	Partial								
11210	13-Jun	10:57	150	150L injected	Partial								
11211	13-Jun	11:10	245	250L injected	Full	7.62	8.7	189	1140	0.53	1.12	967	-42.2
11212	13-Jun	11:22	350	350L injected	Partial								
11213	13-Jun	11:40	492	500L injected	Full	7.64	8.9	184		0.51			
11214	13-Jun	11:52	590	600L injected	Partial								
11215	13-Jun	12:06	700	700L injected	Full	7.62	9.2	188	1110	0.5	1.08	964	-61.5
11216	13-Jun	12:18	800	800L injected	Partial				1130				

11217	13-Jun		895	900L injected	Partial								
11218	13-Jun	12:37	950	End of spike injection	Full	7.62	9.8	184	1140	0.5	1.10	965	
11219	13-Jun	12:37	950	DUP of 11218	Full						1.07	963	-36.0
11222	17-Jun	8:14	10	Start of Extraction	Full	7.38	4.9	176	46.3	1.06	0.0965	39.6	-139.0
11223	17-Jun	8:30	185	15mins	Partial				32.5	1.36			
11224	17-Jun	8:45	315	30mins	Full	7.41	4.6	184	23.8	1.29	0.0816	19.4	-145.9
11225	17-Jun	9:00	450	45mins	Partial				21	1.47			
11226	17-Jun	9:15	575	1hr	Full	7.43	4.6	171	21	1.55	0.0765	16.0	-143.4
11227	17-Jun	9:30	700	1hr 15mins	Partial				16.5	1.45			
11228	17-Jun	9:45	830	1.5hrs	Full	7.38	4.6	171	21.5	1.53	0.0775	16.7	-145.8
11229	17-Jun			DUP of 11228	Full	-	-		-	-	0.0749	9.81	-141.8
11230	17-Jun	10:00	950	1hr 45mins	Partial				11.8	1.67			
11231	17-Jun			BLANK	Full	-	-		-	-	ud	0.0212	-134.4
11232	17-Jun	10:15	1077	2hrs	Full	7.4	4.7	174	12.6	1.54	0.0772	9.62	-144.9
11233	17-Jun	10:30	1212	2hr 15mins	Partial				7.92	1.46			
11234	17-Jun	10:45	1333	2.5hrs	Full	7.44	5	171	14.8	1.5			
11235	17-Jun	11:00	1475	2hrs 45mins	Partial				14.5	1.56			
11236	17-Jun	11:15	1594	3hrs	Full	7.41	5.3	175	13.8	1.47	0.0772	12.3	-149.8
11237	17-Jun	11:30	1737	3hrs 15mins	Partial				10.4	1.45			
11238	17-Jun	11:45	1855	3.5hrs	Full	7.4	5.1	169	9.07	1.51			
11239	17-Jun	12:00	1984	3hrs 45mins	Partial				8.95	1.62			
11240	17-Jun	12:15	2115	4hrs	Full	7.43	5	173	8.62	1.6	0.0737	9.91	-139.0
11241	17-Jun	12:15		DUP of 11239	Full	-	-		-	-	0.0729	10.1	-150.5
11242	17-Jun	12:45	2315	4.5hrs	Partial				7.36	1.45			

11243	17-Jun	1:15	2500	5hrs	Full	7.42	4.9	166	8.24	1.45	0.0728	7.99	-140.7
11244	17-Jun	1:45	2692	5.5hrs	Partial				5.3	1.77			
11245	17-Jun	2:15	2925	6hrs	Full	7.42	4.4	166	8.46	1.73	0.0729	6.56	-146.5
11246	17-Jun	2:45	3178	6.5hrs	Partial				6.82	1.47			
11247	17-Jun	3:15	3424	7hrs	Full	7.42	5.1	174	4.68	1.6	0.0691	7.38	
11248	17-Jun	3:45	3670	7.5hrs	Partial				2.47	1.56			
11249	17-Jun	4:15	3916	8hrs	Full	7.44	5.4	172	4.22	1.42	0.0689	6.19	-151.6
11250	17-Jun	4:45	4162	8.5hrs	Partial				3.35	1.67			
11251	17-Jun	5:15	4408	9hrs	Full	7.41	5.2	168	4.14	1.71	0.0724	5.68	-143.0
11252	17-Jun	5:45		9.5hrs	Partial								
11253	17-Jun	6:00	4647	End of Extraction	Full	7.39	5.1	165	2.16	1.8	0.0692	7.11	-147.1
11254	17-Jun	6:00		DUP of 11253	Full	-	-	-	-	-	0.0718	7.32	-152.2

Table C3. Raw data for push-pull test 2 conducted at well 3 in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (°C)	**Alkalinity** (mg/L as $CaCO_3$)	**Field Cl^-** (mg/L)	**LDO Probe** (mg/L)	**Hydrolab LDO** (mg/L)	**Lab Cl^-** (mg/L)	**NO_3^-** (mg/L as N)	**dD** (‰)
11255	24-Jun	9:03	1	Start of Extraction for Spike water	Full	7.3	8.3	159	4.83	1.32	1.25	3.59	17.6	-147.5
11256	24-Jun	10:35	1035	End of Extraction for Spike water	Full	7.3	9.6	172	3.31	0.79		3.75	13.9	-150.3
11257	24-Jun	11:21	0	Start of Spike	Full	7.65	12.2	166	871	0.52	0.11	762	356	-43.0
11258	24-Jun	11:24	50	50L	Partial									
11259	24-Jun	11:36	151	150L	Partial				839	0.57	0.08			
11260	24-Jun	11:47	254	250L	Full	7.66	12.4	165	882	0.58	0.03	765	360	-44.9
11261	24-Jun			BLANK	Full							0.154	0.0356	-134.4
11262	24-Jun	11:57	345	350L	Partial				822	0.56	0.03			
11263	24-Jun	12:13	496	500L	Full	7.71	13.1	163	822	0.58	0	761	358	-60.8

11264	24-Jun	12:29	600	600L	Partial					0.55	0			
11265	24-Jun	12:35	698	700L	Full	7.75	12.7	164	836	0.4	0.03	749	330	-44.3
11266	24-Jun	12:35	700	DUP of 11265	Full							763	358	-57.9
11267	24-Jun	12:46	800	800L	Partial				815	0.36	0.02			
11268	24-Jun	12:56	898	900L	Partial					0.35	0.01			
11269	24-Jun	1:06	985	End of Spike Injection	Full	7.79	13.3	172	818	0.37		760	352	-60.4
11270	27-Jun	8:08	30	Start of Extraction	Full	7.36	6.2	162	31.9		4.81	26.1	24.3	-144.5
11271	27-Jun	8:20	148	15mins	Partial	7.36	5.9		20.1		4.79			
11272	27-Jun	8:35	275	30mins	Full	7.41	5.8	159	15.4		4.79	15.3	19.6	-142.5
11273	27-Jun	9:00	344	45mins	Partial				14.6		1.58			
11274	27-Jun	9:15	485	1hr	Full	7.39	5.8	163	14.4		1.58	16.2	19.9	-143.2
11275	27-Jun	9:30	632	1hr 15mins	Partial				16.2		1.91			
11276	27-Jun	9:45	773	1.5hrs	Full	7.35	5.9	164	20.8		1.78	13.6	18.7	-142.6
11277	27-Jun	9:45	773	DUP of 11276	Full							15.1	19.4	-149.4
11278	27-Jun	10:00	911	1hr 45mins	Partial				15.1		1.85			
11279	27-Jun	10:15	1053	2hrs	Full	7.43	6.5	157	13.7		1.8	11.7	17.6	-150.1
11280	27-Jun	10:30	1193	2hr 15mins	Partial				13.2		1.87			
11281	27-Jun	10:45	1335	2.5hrs	Full	7.38	6.9		10.7		1.85			
11282	27-Jun	11:00	1448	2hrs 45mins	Partial				12.5		1.76			
11283	27-Jun	11:15	1618	3hrs	Full	7.4	6.9	155	10.2		1.81	12.4	17.9	-146.2
11284	27-Jun	11:30	1730	3hrs 15mins	Partial				11.6		1.89			
11285	27-Jun	11:45	1829	3.5hrs	Full	7.46	6.9	160	9.76		1.82			
11286	27-Jun	12:00	1928	3hrs 45mins	Partial				8.41					
11287	27-Jun	12:15	2031	4hrs	Full	7.48	7.8	158	9.14		1.66	11.6	17.4	-145.4
11288	27-Jun	12:15	2031	DUP of 11287	Full	7.32	7.6	163				12.2	17.7	-142.9
11289	27-Jun	12:45	2225	4.5hrs	Partial				11.2		1.72			
11290	27-Jun	13:15	2419	5hrs	Full	7.38	7.7	161	9.88		1.81	11.9	17.5	-146.4
11291	27-Jun			BLANK	FULL							0.165	0.0712	-135.2
11292	27-Jun	13:45	2683	5.5hrs	Partial				11.1		1.7			

11293	27-Jun	14:15	2978	6hrs	Full	7.45	8.2	152	8.8			10.4	16.8	-151.9
11294	27-Jun	14:45	3250	6.5hrs	Partial				5.93		1.72			
11295	27-Jun	15:15	3529	7hrs	Full	7.44	7.2	153	8.08		2.34	11.3	17.1	-146.9
11296	27-Jun	15:15	3529	DUP of 11295	Full							11.6	17.2	-148.1
11297	27-Jun	15:45	3815	7.5hrs	Partial				5.96		1.87			
11298	27-Jun	16:00	3959	8hrs	Full	7.29	6.8	161	6.47		1.77	10.3	16.7	-149.8
11299	27-Jun	NO	SAMPLE	8.5hrs	Partial									
11300	27-Jun	NO	SAMPLE	9hrs	Full									
11301	27-Jun	NO	SAMPLE	9.5hrs	Partial									
11302	27-Jun	NO	SAMPLE	End of Extraction	Full									

Table C4. Raw data for push-pull test 3 conducted at well 3 in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (°C)	**Alkalinity**	**Field Cl^-** (mg/L)	**LDO Probe** (mg/L)	**Hydrolab LDO** (mg/L)	**Cl^-** (mg/L)	**NO_3^-** (mg/L as N)	**Se** (mg/L)	**dD** (‰)
11305	22-Jul	9:09	10	Start of Extraction for Spike water	Full	7.37	8.3	177	3.72	1.58	1.16	2.95	11.0	0.0631	-144.7
11306	22-Jul	9:36	352	Middle of Extraction 1	Full	7.43	8.2		3.6	1.03	1.2			0.0669	-148.8
11307	22-Jul	10:04	711	Middle of Extraction 2	Full	7.41	8.7		2.59	0.74	1.2	2.62	10.0	0.0626	-148.3
11308	22-Jul	10:43	1200	End of Extraction for Spike water	Full	7.37	8.1	166	3.27	0.55	1.2	2.52	10.7	0.0660	-144.7
11309	22-Jul	11:25	40	Start of Spike	Full	7.74	10.7	168	816	0.26	0.26	374	174	0.756	-41.4
11310	22-Jul	11:25	40	DUP of 11309	Full							761	354	0.764	-54.6
11311	22-Jul	11:26	50	50L	Partial				NA	NA	NA				-49.6
11312	22-Jul	11:38	153	150L	Partial				844	0.24	0.15				-36.6
11313	22-Jul	11:50	250	250L	Full	7.74	9.4	158	833	0.18	0.02	684	319	0.742	-50.5
11314	22-Jul	12:02	350	350L	Partial				837	0.11	0				-53.7
11315	22-Jul	12:21	500	500L	Full	7.97	10.7	165	833	0.04	0	756	343		-70.3
11316	22-Jul	12:33	600	600L	Partial				830	0.05	0				-44.3
11317	22-Jul	12:45	700	700L	Full	7.98	11.4	162	816	0.03	0	493	229	0.731	-56.3
11318	22-Jul	12:57	800	800L	Partial	7.97	11.4		823	0.03	0				-55.5

11319	22-Jul	13:10	900	900L	Partial				820	0.04	0				-39.0
11320	22-Jul	13:20	980	End of Spike Injection	Full	7.96	12.4	157	823	0.02	0	765	360	0.740	-73.0
11321	22-Jul	13:20	980	DUP of 11320	Full							761	355	0.758	-48.4
11322	24-Jul	08:20:00	25	Start of Extraction	Full	7.48	5.7	151	51.8	1.12	0.92	39.8	26.6	0.0940	-137.2
11323	24-Jul	08:35:00	134	15mins	Partial				35.2	1.09	1.06				-136.7
11324	24-Jul	08:50:00	253	30mins	Full	7.4	5.6	151	25.1	1.12	1.23	21.0	18.7	0.0833	-140.7
11325	24-Jul	09:05:00	375	45mins	Partial				20.6	1.16	1.3				-146.7
11326	24-Jul	09:20:00	496	1hr	Full	7.45	6.1	159	22.5	1.2	1.36				-145.7
11327	24-Jul	09:35:00	619	1hr 15mins	Partial				15.9	1.23	1.4				-144.9
11328	24-Jul	09:50:00	739	1.5hrs	Full	7.45	6.4	156	18.5	1.23	1.41	17.0	16.8	0.0803	-146.1
11329	24-Jul	09:50:00	739	DUP of 11328	Full				17.8			12.8	15.3	0.0697	-143.4
11330	24-Jul	10:05:00	860	1hr 45mins	Partial				17	1.24	1.41				-144.8
11331	24-Jul			Blank	Full							n.a.	n.a.	< 0.004	-144.9
11332	24-Jul	10:20:00	981	2hrs	Full	7.48	6.6	154	16.7	1.24	1.42	14.7	15.5	0.0743	-151.4
11333	24-Jul	10:35:00	1102	2hr 15mins	Partial				13.5	1.24	1.41				-142.5
11334	24-Jul	10:50:00	1223	2.5hrs	Full	7.38	6.5	156	13.8	1.24	1.42				-145.1
11335	24-Jul	11:05:00	1323	2hrs 45mins	Partial				12.1	1.25	1.44				-147.1
11336	24-Jul	11:20:00	1415	3hrs	Full	7.4	6.6	155	9.81	1.26	1.44	12.0	14.2	0.0670	-142.0
11337	24-Jul	11:35:00	1507	3hrs 15mins	Partial				10	1.27	1.45				-146.3
11338	24-Jul	11:50:00	1600	3.5hrs	Full	7.4	6.8	158	7.15	1.27	1.45				-145.9
11339	24-Jul	12:05:00	1716	3hrs 45mins	Partial				10.6	1.26	1.44				-147.3
11340	24-Jul	12:20:00	1839	4hrs	Full	7.39	6.2	157	10.1	1.27	1.46	11.5	13.8	0.0719	-146.3
11341	24-Jul	12:20:00	1839	DUP of 11340	Full				10.6	1.26	1.47	11.6	13.8	0.0711	-146.6
11342	24-Jul	12:50:00	2080	4.5hrs	Partial				9.95	1.29	1.49				-146.5
11343	24-Jul	13:20:00	2322	5hrs	Full	7.44	6.4	158	11.2	1.31	1.51	11.4	13.6	0.0760	-145.3
11344	24-Jul	13:50:00	2564	5.5hrs	Partial				8.71	1.33	1.54				-142.6
11345	24-Jul	14:20:00	2810	6hrs	Full	7.49	5.6	157	8.91	1.35	1.56	9.82	12.7	0.0685	-145.3
11346	24-Jul	14:50:00	3051	6.5hrs	Partial				9.73	1.36	1.58				-143.8
11347	24-Jul	15:20:00	3292	7hrs	Full	7.4	5.6	155	8.55	1.38	1.6	2.27	10.9	0.0669	-145.2
11348	24-Jul	15:50:00	3533	7.5hrs	Partial				8.75	1.4	1.61				-147.2

11349	24-Jul		na	8hrs	Full										-145.6
11350	24-Jul		na	8.5hrs	Partial										
11351	24-Jul	16:20:00	3746	End of Extraction	Full	7.41	5.4	155	7.37		1.63	9.00	12.4	0.0686	-143.6
11352	24-Jul	16:20:00	3746	DUP of 11351	Full				8.47			10.6	13.1	0.0679	-142.6

Table C5. Raw data for push-pull test 4 conducted at well 3 in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (°C)	**Alkalinity** (mg/L as $CaCO_3$)	**Field Cl^-** (mg/L)	**Tank LDO** (mg/L)	**Hydrolab LDO** (mg/L)	**Cl^-** (mg/L)	**dD** (‰)
11361	29-Jul	8:37	5	Start of Extraction for Spike water	Full	7.47	8.1	180	9.46	3.61	1.09	8.56	-140.7
11362	29-Jul	9:18	400	Middle of Extraction 1	Full	7.38	9.4	204	5.61	8.6	1.12	8.89	-146.8
11363	29-Jul	10:08	800	Middle of Extraction 2	Full	7.39	10	216	7	8.9	1.12	4.29	-144.0
11364	29-Jul	10:49	1130	End of Extraction for Spike water	Full	7.34	9.7	191	5.54	9.07	11.33	8.88	-139.3
11365	29-Jul	11:44	20	Start of Spike	Full	8.01	14.7	189	816	9.75	11.33	650	-38.8
11366	29-Jul	11:44	20	DUP of 11365	Full				742			651	-22.1
11367	29-Jul	11:47	50	50L	Partial				745				-39.7
11368	29-Jul	12:00	150	150L	Partial				729		10.92		-41.2
11369	29-Jul	12:12	250	250L	Full	8.11	14.6	177	757	9.58	10.86		-48.7
11370	29-Jul	12:24	350	350L	Partial				751	9.49	10.7		-43.1
11371	29-Jul	12:43	500	500L	Full	8.17	15.8	192	770	9.24	10.76		-45.7
11372	29-Jul	12:55	600	600L	Partial				742	9.01	10.38		-44.4
11373	29-Jul	13:07	700	700L	Full	8.23	16.8	182	739	9	10.29	650	-28.0
11374	29-Jul	13:19	800	800L	Partial				729	8.87	10.1		-43.4
11375	29-Jul	13:31	900	900L	Partial				745	8.67	9.9		-25.0
11376	29-Jul	13:41	980	End of Spike Injection	Full	8.3	18.4		823	8.65	9.53	653	-28.5
11377	29-Jul	13:41	980	DUP of 11376	Full	8.31	19.1	184	803			654	-38.2

11378	30-Jul	08:18:00	40	Start of Extraction	Full	7.55	9.1	177	180	na	1.85	143	-121.4
11379	30-Jul	08:30:00	133	15mins	Partial				95.7	1.66	1.35		-135.7
11380	30-Jul	08:45:00	256	30mins	Full	7.42	9.2	172	55	1.3	1.32	41.8	-142.8
11381	30-Jul	09:00:00	376	45mins	Partial				45.4	1.23	1.29		-141.4
11382	30-Jul	09:15:00	498	1hr	Full	7.43	9.9	177	42.6	1.2	1.3	28.8	-142.8
11383	30-Jul	09:30:00	618	1hr 15mins	Partial				48.3	1.2	1.3		-143.9
11384	30-Jul	09:45:00	742	1.5hrs	Full	7.39	11.2	169	40.1	1.17	1.3	22.7	-143.7
11385	30-Jul	09:45:00	742	DUP of 11384	Full				31			23.8	-144.6
11386	30-Jul	10:00:00	862	1hr 45mins	Partial				33.6	1.17	1.29		-143.5
11387	30-Jul			Blank	Full							0.0339	-131.9
11388	30-Jul	10:15:00	985	2hrs	Full	7.35	10.3	174	22.6	1.16	1.29	23.0	-145.2
11389	30-Jul	10:30:00	1098	2hr 15mins	Partial				25.2	1.28	1.3		-140.4
11390	30-Jul	10:45:00	1219	2.5hrs	Full	7.32	10.2	188	21.7	1.19	1.31		-138.9
11391	30-Jul	11:00:00	1341	2hrs 45mins	Partial				20.8	1.18	1.32		-146.2
11392	30-Jul	11:15:00	1443	3hrs	Full	7.42	11.3	179	20.1	1.19	1.34	13.3	-146.0
11393	30-Jul	11:30:00	1535	3hrs 15mins	Partial				22.5	1.2	1.34		-144.9
11394	30-Jul	11:45:00	1626	3.5hrs	Full	7.37	11.8	173	18.3	1.21	1.35		-146.4
11395	30-Jul	12:00:00	1717	3hrs 45mins	Partial				16.4	1.2	1.36		-145.7
11396	30-Jul	12:15:00	1808	4hrs	Full	7.44	11.7	171	18.3	1.25	1.36	14.1	-144.5
11397	30-Jul	12:15:00	1808	DUP of 11396	Full				17.3			14.8	-145.2
11398	30-Jul	12:45:00	1985	4.5hrs	Partial				15.3	1.23	1.37		-148.3
11399	30-Jul	13:15:00	2166	5hrs	Full	7.33	12.1	173	17	1.24	1.4	13.6	-146.5
11400	30-Jul	13:45:00	2346	5.5hrs	Partial				15.9	1.24	1.4		-150.4
11401	30-Jul	14:15:00	2583	6hrs	Full	7.35	11.9	165	15	1.24	1.4	12.9	-147.2

11402	30-Jul	14:45:00	2827	6.5hrs	Partial				16.7	1.26	1.44		-142.8
11403	30-Jul	15:15:00	3067	7hrs	Full	7.35	11.4	183	13.3	na	1.45	11.1	-145.6
11404	30-Jul	15:45:00	3304	7.5hrs	Partial				13.6	1.38	1.48		-141.7
11405	30-Jul	No	Sample	8hrs	Full								
11406	30-Jul	No	Sample	8.5hrs	Partial								
11407	30-Jul	16:15:00	3548	End of Extraction	Full	7.34	11.2	175	14.2	1.31	1.47	10.9	-145.4
11408	30-Jul	16:15:00	3548	DUP of 11407	Full				12			11.2	-141.5

Table C6. Raw data for push-pull test 1 conducted at well 1D in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (ºC)	**Alkalinity** (mg/L as CaCO3)	**Field Cl^-** (mg/L)	**Tank LDO** (mg/L)	**Hydrolab LDO** (mg/L)	**Cl^-** (mg/L)	**δD** (‰)
11409	06-Aug	9:27	7	Start of Extraction for Spike water	Full	7.53	7.4	367	3.84	na	0	3.47	-148.0
11410	06-Aug	10:00	350	Middle of Extraction 1	Full	7.09	8.4		4.08	0.04	0	3.68	-143.4
11411	06-Aug	10:42	800	Middle of Extraction 2	Full	6.93	8.7		4.29	0.02	0	3.72	-147.6
11412	06-Aug	11:15	1130	End of Extraction for Spike water	Full	7.02	8.9	376	4.34	0.01	0	3.42	-145.7
11413	06-Aug	11:53	50	Start of Spike	Full	7.65	12.6	381	832	9.78	11.73	638	-50.6
11414	06-Aug	11:53	50	DUP of 11414	Full				766			644	-45.0
11415	06-Aug	No	Sample	50L	Partial								
11416	06-Aug	12:02	150	150L	Partial				789	9.78	11.12		-57.8
11417	06-Aug	12:12	250	250L	Full	7.8	12.9	392	776	9.8	11.09	635	-33.1
11418	06-Aug	12:21	350	350L	Partial				789	9.75	11.03		-68.7
11419	06-Aug	12:35	500	500L	Full	7.92	13.9	408	792	9.65	10.89		-49.0
11420	06-Aug	12:45	600	600L	Partial				792	9.56	10.81		-44.1
11421	06-Aug	12:54	700	700L	Full	7.98	14.2	401	805	9.45	10.65	634	-32.7

11422	06-Aug	13:03	800	800L	Partial				798	9.4	10.55		-54.2
11423	06-Aug	13:13	900	900L	Partial				782	9.21	10.4		-70.6
11424	06-Aug	13:20	975	End of Spike Injection	Full	8.07	15.4	404	933	9.1	10.32	634	-47.4
11425	06-Aug	13:20	975	DUP of 11424	Full				839			635	-35.9
11426	07-Aug	08:24:00	40	Start of Extraction	Full	7.22	10	369	837		1.87	566	-62.1
11427	07-Aug	08:30:00	77	15mins	Partial				804	3.77	1.71		-77.2
11428	07-Aug	08:45:00	169	30mins	Full	7.08	8.7	384	442	1.16	0.58	370	-91.2
11429	07-Aug	09:00:00	260	45mins	Partial				329	0.43	0.14		-110.7
11430	07-Aug	09:15:00	352	1hr	Full	7.03	8.9	391	271	0.28	0	240	-105.0
11431	07-Aug	09:30:00	441	1hr 15mins	Partial				239	0.21	0		-113.7
11432	07-Aug	09:45:00	534	1.5hrs	Full	6.94	8.8	391	224	0.15	0	192	-117.8
11433	07-Aug	09:45:00	534	DUP of 11432	Full	6.98	9.1	397	222			192	-118.0
11434	07-Aug	10:00:00	628	1hr 45mins	Partial				200	0.13	0	192	-117.9
11435	07-Aug	10:23:00		Blank	Full							0.269	-135.4
11436	07-Aug	10:15:00	723	2hrs	Full	6.95	8.9	392	193	0.11	0	157	-123.1
11437	07-Aug	10:30:00	814	2hr 15mins	Partial				171	0.1	0		-125.4
11438	07-Aug	10:45:00	906	2.5hrs	Full	6.95	9.1	396	146	0.08	0		-129.8
11439	07-Aug	11:00:00	998	2hrs 45mins	Partial				133	0.07	0		-128.6
11440	07-Aug	11:15:00	1091	3hrs	Full	6.94	8.6	393	113	0.06	0	93.4	-134.9
11441	07-Aug	11:30:00	1184	3hrs 15mins	Partial				103	0.05	0		-139.4
11442	07-Aug	11:45:00	1278	3.5hrs	Full	6.92	9	411	78.8	0.05	0		-129.3
11443	07-Aug	12:00:00	1370	3hrs 45mins	Partial				73.8	0.04	0		-132.8
11444	07-Aug	12:15:00	1464	4hrs	Full	6.9	9.6	391	64.4	0.04	0	62.2	-138.1
11445	07-Aug	12:15:00	1464	DUP of 11444	Full	6.9	9.2	394	63.4			61.4	-134.9

11446	07-Aug	12:45:00	1648	4.5hrs	Partial				52.3	0.03	0	61.8	-136.5
11447	07-Aug	13:15:00	1831	5hrs	Full	6.95	9.8	388	50.3	0.02	0	46.6	-138.5
11448	07-Aug	13:45:00	2018	5.5hrs	Partial				49.3	0.01	0		-138.0
11449	07-Aug	14:15:00	2206	6hrs	Full	6.92	9.8	385	45.9	0.01	0	38.4	-140.2
11450	07-Aug	14:45:00	2393	6.5hrs	Partial				42.2	0.01	0		-140.2
11451	07-Aug	15:15:00	2579	7hrs	Full	6.94	10.3	382	38.6	0	0	33.3	-139.3
11452	07-Aug	15:45:00	2763	7.5hrs	Partial				38.2	0	0		-139.7
11453	07-Aug	No	Sample	8hrs	Full								
11454	07-Aug	No	Sample	8.5hrs	Partial								

Table C7. Raw data for push-pull test 2 conducted at well 1D in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (^{O}C)	**Alkalinity** (mg/L as $CaCO_3$)	**Field Cl^-** (mg/L)	**Tank LDO** (mg/L)	**Hydrolab LDO** (mg/L)	**Cl^-** (mg/L)	**Se** (mg/L)	**dD** (‰)
11459	15-Aug	9:08	25	Start of Extraction for Spike water	Full	6.9	7	373	29.4	0.26	0	23.73	0.0895	-143.8
11460	15-Aug	9:52	490	Middle of Extraction 1	Full	6.9	7		23.8	0.08	0	19.74	0.107	-143.2
11461	15-Aug	10:22	800	Middle of Extraction 2	Full	6.9	6.8		19.8	0.04	0	18.10	0.0877	-144.7
11462	15-Aug	10:58	1172	End of Extraction for Spike water	Full	6.95	7.3	386	22.5	0.02	0	16.93	0.112	-141.0
11463	15-Aug	11:41	40	Start of Spike	Full	7.23	10.2	383	847	0.52	0.54	707	0.918	-41.9
11464	15-Aug	11:41	40	DUP of 11463	Full				818			709	0.862	-51.9
11465	15-Aug	No	Sample	50L	Partial									
11466	15-Aug	11:53	150	150L	Partial				822	0.61	0.56			-41.9
11467	15-Aug	12:03	250	250L	Full	7.43	11.7	387	889	0.74	0.72	711	0.929	-46.2

11468	15-Aug	12:14	350	350L	Partial				897	1.01	1.05			-55.6
11469	15-Aug	12:30	500	500L	Full	7.59	12.1	394	945	1.55	1.58			-29.7
11470	15-Aug	12:40	600	600L	Partial				908	1.7	1.71			-46.2
11471	15-Aug	12:51	700	700L	Full	7.71	12.6	383	912	1.64	1.63	709	0.926	-45.3
11472	15-Aug	No	Sample	800L	Partial				870	1.66	1.63			
11473	15-Aug	13:12	900	900L	Partial				873	1.64	1.65			-48.4
11474	15-Aug	13:22	985	End of Spike Injection	Full	7.71	13.4	385	916	1.59	1.94	709	0.923	-45.4
11475	15-Aug	13:22	985	DUP of 11474	Full				901			707	0.910	-44.6
11476	18-Aug	08:18:00	30	Start of Extraction	Full	7	7.2	373	358		0	396	0.470	-90.0
11477	18-Aug	08:30:00	108	15mins	Partial				285		0			-103.7
11478	18-Aug	08:45:00	209	30mins	Full	6.9	7.2	383	229		0	248	0.330	-110.8
11479	18-Aug	09:00:00	306	45mins	Partial				186		0			-114.2
11480	18-Aug	09:15:00	405	1hr	Full	6.87	7.6	368	171		0	194	0.284	-119.4
11481	18-Aug	09:30:00	504	1hr 15mins	Partial				161		0			-122.0
11482	18-Aug	09:45:00	604	1.5hrs	Full	6.92	7.7	373	167		0	173	0.245	-125.1
11483	18-Aug	09:45:00	604	DUP of 11482	Full				157		0	173	0.279	-126.9
11484	18-Aug	10:00:00	703	1hr 45mins	Partial				150		0			
11485	18-Aug	10:30:00	NA	Blank	Full							0.129	< 0.004	-130.2
11486	18-Aug	10:15:00	802	2hrs	Full	6.83	8.2	387	146		0	150	0.222	-124.2
11487	18-Aug	10:30:00	902	2hr 15mins	Partial				132		0			-127.9
11488	18-Aug	10:45:00	1002	2.5hrs	Full	6.82	8.4	376	120		0			-129.1
11489	18-Aug	11:00:00	1102	2hrs 45mins	Partial				110		0			-127.0
11490	18-Aug	11:15:00	1202	3hrs	Full	6.86	8.8	381	103		0	107	0.177	-133.4
11491	18-Aug	11:30:00	1301	3hrs 15mins	Partial				94.5		0			-128.3

11492	18-Aug	11:45:00	1400	3.5hrs	Full	6.82	8.8	372	88.6		0			-133.1
11493	18-Aug	12:00:00	1500	3hrs 45mins	Partial				87.1		0			-133.6
11494	18-Aug	12:15:00	1600	4hrs	Full	6.83	8.9	379	77.7		0	76.0	0.183	-139.0
11495	18-Aug	12:15:00	1600	DUP of 11494	Full				77.7		0	78.2	0.188	-133.3
11496	18-Aug	12:45:00	1796	4.5hrs	Partial				72.4		0			
11497	18-Aug	13:15:00	1993	5hrs	Full	6.81	8.8	372	64.1		0	58.4	0.162	-134.1
11498	18-Aug	13:45:00	2189	5.5hrs	Partial				67.7		0			-138.8
11499	18-Aug	14:15:00	2387	6hrs	Full	6.8	9.8	383	61.3		0	48.3	0.155	-138.1
11500	18-Aug	14:45:00	2586	6.5hrs	Partial				57.5		0			-140.1
11501	18-Aug	15:15:00	2780	7hrs	Full	6.8	9.6	361	47.2		0	41.7	0.125	-140.2
11502	18-Aug	15:45:00	2980	7.5hrs	Partial				50		0			-138.6
11503	18-Aug	16:15:00	3174	End of Extraction	Full	6.82	9.5	382	50		0	37.6	0.149	-137.7
11504	18-Aug	16:15:00	3174	DUP of 11503	Full				47.6			37.5	0.146	0.0

Table C8. Raw data for push-pull test 3 conducted at well 1D in 2014.

Sample ID	**Date**	**Time**	**Volume** (L)	**Description**	**Analysis Type**	**pH**	**Temp** (°C)	**Alkalinity** (mg/L as CaCO3)	**Field Cl^-** (mg/L)	**Tank LDO** (mg/L)	**Hydrolab LDO** (mg/L)	**Cl^-** (mg/L)	**Se** (mg/L)	**NO3** (mg/L as N)	**dD** (‰)
11505	22-Aug	9:29	0	Start of Extraction for Spike water	Full	6.89	5.4	378	41.9	1.06	0	33.3	0.113	151	-142.7
11506	22-Aug	10:01	300	Middle of Extraction 1	Full	6.89	5.7		35.9	0.95	0	30.3	0.121	154	-140.2
11507	22-Aug	10:44	700	Middle of Extraction 2	Full	6.87	6.1		32.3	1.3	0	26.7	0.107	151	-140.0
11508	22-Aug	11:34	1125	End of Extraction for Spike water	Full	6.9	6.1	386	28.9	1.07	0	24.4	0.123	153	-145.9
11509	22-Aug	12:25	40	Start of Spike	Full	7.2	6.8	382	759	1.51	1.74	725	0.937	354	-38.2
11510	22-Aug	12:25	40	DUP of 11509	Full				733			736	0.939	357	-51.8
11511	22-Aug	12:32	100	100L	Partial				725	1.5	1.7				

11512	22-Aug	12:51	250	250L	Full	7.42	7	383	718	1.42	1.52	739	0.881	359	-54.9
11513	22-Aug	13:23	500	500L	Full	7.55	7.2	381	733	1.85	1.98				
11514	22-Aug	13:48	700	700L	Full	7.74	7.2	380	759	1.32	1.45	738	0.887	358	-65.5
11515	22-Aug	No	Sample	850L	Partial										
11516	22-Aug	14:22	900	End of Spike Injection	Full	7.73	7.2	374	850	1.37	1.6	725	0.938	355	-52.3
11517	22-Aug	14:22	900	DUP of 11516	Full				795			737	0.840	358	-41.5
11518	25-Aug	08:17	40	Start of Extraction	Full	6.89	5.6	392	302		0	297	0.382	229	-110.7
11519	25-Aug	08:30	126	15mins	Partial				249		0				
11520	25-Aug	08:45	226	30mins	Full	6.84	5.8	390	200		0	210	0.255	213	-113.3
11521	25-Aug	09:00	328	45mins	Partial				167		0				
11522	25-Aug	09:15	428	1hr	Full	6.83	6.2	385	160		0	163	0.260	198	-121.3
11523	25-Aug	09:30	529	1hr 15mins	Partial				141		0				
11524	25-Aug	09:45	630	1.5hrs	Full	6.82	6.7	374	133		0	148	0.231	189	-126.7
11525	25-Aug	09:45	630	DUP of 11524	Full				126		0	148	0.232	188	-120.9
11526	25-Aug	10:00	733	1hr 45mins	Partial				124		0				
11527	25-Aug		na	Blank	Full							0.135	< 0.004	0.0605	-140.6
11528	25-Aug	10:15	832	2hrs	Full	6.8	6.8	380	122		0	135	0.257	182	-128.3
11529	25-Aug	10:30	932	2hr 15mins	Partial				117		0				
11530	25-Aug	10:45	1033	2.5hrs	Full	6.79	6.9	380	114		0				
11531	25-Aug	11:00	1133	2hrs 45mins	Partial				96.3		0				
11532	25-Aug	11:15	1233	3hrs	Full	6.78	8.1	373	92.8		0	101	0.217	179	-131.1
11533	25-Aug	11:30	1333	3hrs 15mins	Partial				83.7		0				
11534	25-Aug	11:45	1432	3.5hrs	Full	6.82	7.9	393	78.7		0				
11535	25-Aug	12:00	1532	3hrs 45mins	Partial				74		0				

11536	25-Aug	12:15	1632	4hrs	Full	6.77	8.2	379	71.5		0	76.8	0.196	171	-137.8
11537	25-Aug	12:15	1632	DUP of 11536	Full				62.9		0	77.6	0.166	168	-133.5
11538	25-Aug	12:45	1831	4.5hrs	Partial				62.5		0				
11539	25-Aug	13:15	1978	5hrs	Full	6.75	8.2	386	48.1		0	64.3	0.155	161	-137.1
11540	25-Aug	13:45	2119	5.5hrs	Partial				69		0				
11541	25-Aug	14:15	2261	6hrs	Full	6.78	7.9	385	59.8		0	57.5	0.152	160	-139.6
11542	25-Aug	14:45	2402	6.5hrs	Partial				55.4		0				
11543	25-Aug	15:15	2591	7hrs	Full	6.79	7.2	389	57.2		0	50.5	0.149	162	-138.9
11544	25-Aug	15:45	2791	7.5hrs	Partial				53.2		0				
11545	25-Aug	16:15	2991	End of Extraction	Full	6.77	7.8	387	50.7		0	44.0	0.152	156	-142.7
11546	25-Aug	16:15	2991	DUP of 11545	Full				42.7		0	44.3	0.141	156	-139.7

Table C9. Hydrolab data for push-pull test 1 conducted at well 1D in 2014.

INJECTION								EXTRACTION							
Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)	Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)
8/6/2014	8:44:00	4.74	4017	2.6	6.97	139	0	8/7/2014	7:51:00	16.17	0	0	7.39	141	9.18
8/6/2014	8:45:00	4.74	4028	2.6	6.87	138	0	8/7/2014	7:52:00	16.14	0	0	7.39	144	9.19
8/6/2014	8:46:00	4.74	4032	2.6	6.87	137	0	8/7/2014	7:53:00	16.1	0	0	7.39	147	9.23
8/6/2014	8:47:00	4.75	4026	2.6	6.87	136	0	8/7/2014	7:54:00	16.07	0	0	7.39	149	9.23
8/6/2014	8:48:00	4.75	4025	2.6	6.87	135	0	8/7/2014	7:55:00	16.05	0	0	7.39	150	9.24
8/6/2014	8:49:00	4.75	4027	2.6	6.87	135	0	8/7/2014	7:56:00	16.08	0	0	7.4	152	9.17
8/6/2014	8:50:00	4.75	4025	2.6	6.87	134	0	8/7/2014	7:57:00	16.16	0	0	7.4	154	9.19
8/6/2014	8:51:00	4.73	4030	2.6	6.88	134	0	8/7/2014	7:58:00	16.24	0	0	7.4	156	9.13
8/6/2014	8:52:00	4.75	4016	2.6	6.88	133	0	8/7/2014	7:59:00	16.32	0	0	7.39	157	9.12
8/6/2014	8:53:00	4.73	4028	2.6	6.88	133	0	8/7/2014	8:00:00	16.4	0	0	7.37	157	9.07
8/6/2014	8:54:00	4.71	4022	2.6	6.87	132	0	8/7/2014	8:01:00	16.47	0	0	7.39	158	9.06

8/6/2014	8:55:00	4.71	4021	2.6	6.88	132	0	8/7/2014	8:02:00	16.57	0	0	7.38	160	9.02
8/6/2014	8:56:00	4.69	4022	2.6	6.88	131	0	8/7/2014	8:03:00	16.61	0	0	7.31	165	9
8/6/2014	8:57:00	4.69	4026	2.6	6.87	131	0	8/7/2014	8:04:00	16.61	0	0	7.3	165	8.98
8/6/2014	8:58:00	4.69	4026	2.6	6.88	130	0	8/7/2014	8:05:00	16.61	0	0	7.31	166	8.95
8/6/2014	8:59:00	4.68	4021	2.6	6.88	130	0	8/7/2014	8:06:00	16.6	0	0	7.27	167	8.96
8/6/2014	9:00:00	4.67	4022	2.6	6.87	130	0	8/7/2014	8:07:00	16.56	0	0	7.29	163	8.93
8/6/2014	9:01:00	4.66	4017	2.6	6.87	129	0	8/7/2014	8:08:00	16.52	0	0	7.3	164	8.97
8/6/2014	9:02:00	4.67	4017	2.6	6.87	129	0	8/7/2014	8:09:00	16.48	0	0	7.32	166	8.96
8/6/2014	9:03:00	4.69	4019	2.6	6.87	128	0	8/7/2014	8:10:00	16.44	0	0	7.34	173	8.97
8/6/2014	9:04:00	4.71	4022	2.6	6.89	128	0	8/7/2014	8:11:00	16.4	0	0	7.32	195	8.95
8/6/2014	9:05:00	4.81	4016	2.6	6.88	128	0	8/7/2014	8:12:00	16.35	0	0	7.32	201	8.95
8/6/2014	9:06:00	4.82	4014	2.6	6.92	127	0	8/7/2014	8:13:00	16.29	0	0	7.32	201	8.98
8/6/2014	9:07:00	4.82	4020	2.6	6.88	127	0	8/7/2014	8:14:00	16.24	0	0	7.35	200	9.01
8/6/2014	9:08:00	4.81	4015	2.6	6.87	127	0	8/7/2014	8:15:00	10.93	3832	2.5	7.09	199	9.63
8/6/2014	9:09:00	4.81	4012	2.6	6.88	126	0	8/7/2014	8:16:00	5.76	5587	3.6	7.24	198	5.62
8/6/2014	9:10:00	4.82	4012	2.6	6.88	126	0	8/7/2014	8:17:00	6.59	5673	3.6	7.27	200	2.73
8/6/2014	9:11:00	4.82	4009	2.6	6.87	126	0	8/7/2014	8:18:00	7.37	5602	3.6	7.31	197	3.22
8/6/2014	9:12:00	4.71	4013	2.6	6.88	125	0	8/7/2014	8:19:00	7.51	5605	3.6	7.3	196	3.13
8/6/2014	9:13:00	4.7	4008	2.6	6.88	125	0	8/7/2014	8:20:00	6.04	5668	3.6	7.31	195	3.75
8/6/2014	9:14:00	4.69	4008	2.6	6.88	125	0	8/7/2014	8:21:00	6.71	5696	3.6	7.28	193	2.61
8/6/2014	9:15:00	4.69	4009	2.6	6.87	124	0	8/7/2014	8:22:00	6.99	5665	3.6	7.29	191	2.48
8/6/2014	9:16:00	4.7	4005	2.6	6.87	124	0	8/7/2014	8:23:00	7.16	5646	3.6	7.28	190	2.38
8/6/2014	9:17:00	4.68	4004	2.6	6.87	124	0	8/7/2014	8:24:00	7.27	5628	3.6	7.27	189	2.33
8/6/2014	9:18:00	4.69	4005	2.6	6.86	124	0	8/7/2014	8:25:00	7.26	5626	3.6	7.26	189	2.27
8/6/2014	9:19:00	4.69	4004	2.6	6.86	124	0	8/7/2014	8:26:00	7.22	5606	3.6	7.26	188	2.22
8/6/2014	9:20:00	4.67	4006	2.6	6.87	123	0	8/7/2014	8:27:00	7.13	5589	3.6	7.25	188	2.19
8/6/2014	9:21:00	4.66	4001	2.6	6.87	123	0	8/7/2014	8:28:00	7.03	5560	3.6	7.24	187	2.1
8/6/2014	9:22:00	4.66	4006	2.6	6.87	123	0	8/7/2014	8:29:00	7.02	5527	3.5	7.21	186	2.02
8/6/2014	9:23:00	4.66	3999	2.6	6.87	123	0	8/7/2014	8:30:00	7.03	5493	3.5	7.2	186	1.92
8/6/2014	9:24:00	4.68	3998	2.6	6.86	122	0	8/7/2014	8:31:00	6.91	5452	3.5	7.24	185	1.75

8/6/2014	9:25:00	4.68	4002	2.6	6.89	122	0	8/7/2014	8:32:00	6.83	5414	3.5	7.19	185	1.62
8/6/2014	9:26:00	4.68	3996	2.6	6.87	122	0	8/7/2014	8:33:00	6.8	5377	3.4	7.16	185	1.47
8/6/2014	9:27:00	4.68	3999	2.6	6.87	122	0	8/7/2014	8:34:00	6.78	5347	3.4	7.14	185	1.36
8/6/2014	9:28:00	4.83	3987	2.6	6.87	122	0	8/7/2014	8:35:00	6.73	5324	3.4	7.15	184	1.25
8/6/2014	9:29:00	4.75	3997	2.6	6.87	122	0	8/7/2014	8:36:00	6.68	5296	3.4	7.14	184	1.15
8/6/2014	9:30:00	4.59	3994	2.6	6.88	122	0	8/7/2014	8:37:00	6.65	5271	3.4	7.13	184	1.05
8/6/2014	9:31:00	4.66	3998	2.6	6.87	121	0	8/7/2014	8:38:00	6.62	5225	3.3	7.12	183	0.98
8/6/2014	9:32:00	4.73	3997	2.6	6.87	121	0	8/7/2014	8:39:00	6.58	5214	3.3	7.11	183	0.89
8/6/2014	9:33:00	4.72	3998	2.6	6.87	121	0	8/7/2014	8:40:00	6.56	5188	3.3	7.11	183	0.82
8/6/2014	9:34:00	4.77	3998	2.6	6.86	120	0	8/7/2014	8:41:00	6.53	5172	3.3	7.11	183	0.8
8/6/2014	9:35:00	4.8	3992	2.6	6.87	120	0	8/7/2014	8:42:00	6.51	5147	3.3	7.1	183	0.76
8/6/2014	9:36:00	4.81	3993	2.6	6.86	120	0	8/7/2014	8:43:00	6.5	5120	3.3	7.11	183	0.7
8/6/2014	9:37:00	4.81	3997	2.6	6.86	120	0	8/7/2014	8:44:00	6.58	5106	3.3	7.08	183	0.65
8/6/2014	9:38:00	4.75	3996	2.6	6.87	120	0	8/7/2014	8:45:00	6.52	5073	3.2	7.08	183	0.6
8/6/2014	9:39:00	4.82	3990	2.6	6.86	120	0	8/7/2014	8:46:00	6.4	5051	3.2	7.07	183	0.51
8/6/2014	9:40:00	4.82	3995	2.6	6.89	119	0	8/7/2014	8:47:00	6.4	5031	3.2	7.08	183	0.48
8/6/2014	9:41:00	4.82	3990	2.6	6.87	119	0	8/7/2014	8:48:00	6.39	5015	3.2	7.06	183	0.46
8/6/2014	9:42:00	4.78	3993	2.6	6.87	119	0	8/7/2014	8:49:00	6.42	5001	3.2	7.07	182	0.48
8/6/2014	9:43:00	4.72	3994	2.6	6.87	119	0	8/7/2014	8:50:00	6.42	4976	3.2	7.05	182	0.43
8/6/2014	9:44:00	4.73	3993	2.6	6.88	119	0	8/7/2014	8:51:00	6.41	4964	3.2	7.05	182	0.39
8/6/2014	9:45:00	4.77	3993	2.6	6.85	119	0	8/7/2014	8:52:00	6.42	4950	3.2	7.06	182	0.36
8/6/2014	9:46:00	4.64	3991	2.6	6.88	120	0	8/7/2014	8:53:00	6.4	4928	3.2	7.04	182	0.34
8/6/2014	9:47:00	4.81	3984	2.5	6.88	118	0	8/7/2014	8:54:00	6.39	4903	3.1	7.05	182	0.31
8/6/2014	9:48:00	4.59	3990	2.6	6.88	118	0	8/7/2014	8:55:00	6.4	4901	3.1	7.04	182	0.26
8/6/2014	9:49:00	4.72	3976	2.5	6.88	118	0	8/7/2014	8:56:00	6.38	4891	3.1	7.07	182	0.28
8/6/2014	9:50:00	4.74	3990	2.6	6.89	118	0	8/7/2014	8:57:00	6.42	4877	3.1	7.03	182	0.25
8/6/2014	9:51:00	4.78	3982	2.5	6.88	118	0	8/7/2014	8:58:00	6.41	4863	3.1	7.02	182	0.14
8/6/2014	9:52:00	4.61	3987	2.6	6.88	118	0	8/7/2014	8:59:00	6.36	4848	3.1	7.04	182	0.19
8/6/2014	9:53:00	4.7	3987	2.6	6.88	118	0	8/7/2014	9:00:00	6.48	4835	3.1	7.01	182	0.01
8/6/2014	9:54:00	4.79	3992	2.6	6.88	118	0	8/7/2014	9:01:00	6.38	4828	3.1	7.01	182	0

8/6/2014	9:55:00	4.63	3988	2.6	6.88	118	0	8/7/2014	9:02:00	6.35	4817	3.1	7.02	182	0
8/6/2014	9:56:00	4.75	3988	2.6	6.88	117	0	8/7/2014	9:03:00	6.34	4802	3.1	7.01	182	0
8/6/2014	9:57:00	4.76	3988	2.6	6.88	117	0	8/7/2014	9:04:00	6.32	4792	3.1	7.01	182	0
8/6/2014	9:58:00	4.88	3984	2.5	6.89	117	0	8/7/2014	9:05:00	6.31	4783	3.1	7.01	182	0
8/6/2014	9:59:00	4.63	3983	2.5	6.93	117	0	8/7/2014	9:06:00	6.34	4771	3.1	7.02	182	0
8/6/2014	10:00:00	4.89	3979	2.5	6.89	117	0	8/7/2014	9:07:00	6.32	4762	3	7.01	182	0
8/6/2014	10:01:00	4.64	3989	2.6	6.91	117	0	8/7/2014	9:08:00	6.29	4754	3	7.01	182	0
8/6/2014	10:02:00	4.78	3982	2.5	6.9	117	0	8/7/2014	9:09:00	6.26	4745	3	7.01	182	0
8/6/2014	10:03:00	4.79	3982	2.5	6.9	117	0	8/7/2014	9:10:00	6.24	4737	3	7	182	0
8/6/2014	10:04:00	4.79	3981	2.5	6.88	117	0	8/7/2014	9:11:00	6.23	4734	3	7.01	182	0
8/6/2014	10:05:00	4.78	3981	2.5	6.91	117	0	8/7/2014	9:12:00	6.2	4718	3	7	182	0
8/6/2014	10:06:00	4.77	3984	2.5	6.89	116	0	8/7/2014	9:13:00	6.2	4722	3	6.99	182	0
8/6/2014	10:07:00	4.76	3985	2.6	6.9	116	0	8/7/2014	9:14:00	6.19	4703	3	7.02	182	0
8/6/2014	10:08:00	4.74	3982	2.5	6.89	116	0	8/7/2014	9:15:00	6.34	4693	3	6.99	182	0
8/6/2014	10:09:00	4.83	3980	2.5	6.9	116	0	8/7/2014	9:16:00	6.14	4695	3	7.01	182	0
8/6/2014	10:10:00	4.67	3983	2.5	6.89	116	0	8/7/2014	9:17:00	6.11	4688	3	7.01	182	0
8/6/2014	10:11:00	4.77	3981	2.5	6.9	116	0	8/7/2014	9:18:00	6.16	4679	3	6.9	182	0
8/6/2014	10:12:00	4.76	3980	2.5	6.89	116	0	8/7/2014	9:19:00	6.13	4669	3	6.99	182	0
8/6/2014	10:13:00	4.77	3984	2.5	6.89	116	0	8/7/2014	9:20:00	6.1	4678	3	6.98	182	0
8/6/2014	10:14:00	4.74	3981	2.5	6.92	116	0	8/7/2014	9:21:00	6.12	4672	3	6.99	182	0
8/6/2014	10:15:00	4.75	3980	2.5	6.66	117	0	8/7/2014	9:22:00	6.07	4657	3	6.97	182	0
8/6/2014	10:16:00	4.73	3978	2.5	6.8	116	0	8/7/2014	9:23:00	6.11	4656	3	6.99	182	0
8/6/2014	10:17:00	4.73	3980	2.5	6.86	116	0	8/7/2014	9:24:00	6.12	4645	3	6.92	181	0
8/6/2014	10:18:00	4.73	3982	2.5	6.88	116	0	8/7/2014	9:25:00	6.1	4648	3	6.98	181	0
8/6/2014	10:19:00	4.77	3977	2.5	6.91	116	0	8/7/2014	9:26:00	6.08	4637	3	6.98	181	0
8/6/2014	10:20:00	4.78	3978	2.5	6.9	116	0	8/7/2014	9:27:00	6.05	4632	3	6.98	181	0
8/6/2014	10:21:00	4.79	3983	2.5	7.02	115	0	8/7/2014	9:28:00	6.02	4633	3	6.99	181	0
8/6/2014	10:22:00	4.82	3976	2.5	7.06	115	0	8/7/2014	9:29:00	6.04	4624	3	6.94	181	0
8/6/2014	10:23:00	4.8	3979	2.5	6.99	115	0	8/7/2014	9:30:00	6.2	4607	2.9	6.97	181	0
8/6/2014	10:24:00	4.85	3982	2.5	6.92	115	0	8/7/2014	9:31:00	5.99	4613	3	7	181	0

8/6/2014	10:25:00	4.83	3981	2.5	6.91	115	0	8/7/2014	9:32:00	5.97	4610	3	7	181	0
8/6/2014	10:26:00	4.81	3975	2.5	6.92	115	0	8/7/2014	9:33:00	5.96	4593	2.9	6.96	181	0
8/6/2014	10:27:00	4.8	3981	2.5	6.92	115	0	8/7/2014	9:34:00	5.98	4596	2.9	6.97	181	0
8/6/2014	10:28:00	4.8	3976	2.5	6.92	115	0	8/7/2014	9:35:00	5.96	4594	2.9	6.97	181	0
8/6/2014	10:29:00	4.76	3981	2.5	6.92	115	0	8/7/2014	9:36:00	5.95	4588	2.9	6.98	181	0
8/6/2014	10:30:00	4.77	3976	2.5	6.91	115	0	8/7/2014	9:37:00	5.95	4583	2.9	6.95	181	0
8/6/2014	10:31:00	4.75	3976	2.5	6.91	115	0	8/7/2014	9:38:00	5.96	4575	2.9	6.96	181	0
8/6/2014	10:32:00	4.78	3977	2.5	6.94	115	0	8/7/2014	9:39:00	5.96	4578	2.9	6.97	181	0
8/6/2014	10:33:00	4.79	3975	2.5	6.92	114	0	8/7/2014	9:40:00	5.96	4574	2.9	6.96	181	0
8/6/2014	10:34:00	4.83	3980	2.5	6.92	114	0	8/7/2014	9:41:00	5.98	4568	2.9	6.96	181	0
8/6/2014	10:35:00	4.83	3980	2.5	6.9	114	0	8/7/2014	9:42:00	5.96	4564	2.9	7.02	181	0
8/6/2014	10:36:00	4.8	3980	2.5	6.92	114	0	8/7/2014	9:43:00	5.98	4560	2.9	6.95	181	0
8/6/2014	10:37:00	4.8	3981	2.5	6.92	114	0	8/7/2014	9:44:00	5.91	4554	2.9	6.98	181	0
8/6/2014	10:38:00	4.83	3979	2.5	6.97	114	0	8/7/2014	9:45:00	6.06	4548	2.9	6.97	181	0
8/6/2014	10:39:00	4.83	3980	2.5	6.9	114	0	8/7/2014	9:46:00	5.88	4545	2.9	6.99	181	0
8/6/2014	10:40:00	4.86	3979	2.5	6.97	114	0	8/7/2014	9:47:00	5.81	4546	2.9	6.98	181	0
8/6/2014	10:41:00	4.76	3980	2.5	6.93	114	0	8/7/2014	9:48:00	5.88	4541	2.9	6.97	181	0
8/6/2014	10:42:00	4.78	3974	2.5	6.93	114	0	8/7/2014	9:49:00	5.85	4516	2.9	6.95	181	0
8/6/2014	10:43:00	4.94	3972	2.5	6.94	114	0	8/7/2014	9:50:00	5.85	4536	2.9	6.97	181	0
8/6/2014	10:44:00	4.72	3980	2.5	6.97	114	0	8/7/2014	9:51:00	5.84	4527	2.9	6.97	181	0
8/6/2014	10:45:00	4.81	3974	2.5	6.97	114	0	8/7/2014	9:52:00	5.9	4514	2.9	6.97	181	0
8/6/2014	10:46:00	4.84	3974	2.5	6.92	114	0	8/7/2014	9:53:00	5.93	4517	2.9	6.96	181	0
8/6/2014	10:47:00	4.86	3977	2.5	6.93	114	0	8/7/2014	9:54:00	5.9	4513	2.9	6.96	181	0
8/6/2014	10:48:00	4.86	3979	2.5	6.92	114	0	8/7/2014	9:55:00	5.85	4508	2.9	6.98	181	0
8/6/2014	10:49:00	4.83	3978	2.5	6.92	114	0	8/7/2014	9:56:00	5.91	4505	2.9	6.99	181	0
8/6/2014	10:50:00	4.83	3975	2.5	6.92	113	0	8/7/2014	9:57:00	5.9	4501	2.9	6.98	181	0
8/6/2014	10:51:00	4.78	3973	2.5	6.93	113	0	8/7/2014	9:58:00	5.87	4499	2.9	6.97	181	0
8/6/2014	10:52:00	4.81	3980	2.5	6.94	113	0	8/7/2014	9:59:00	5.92	4492	2.9	6.96	181	0
8/6/2014	10:53:00	4.79	3977	2.5	6.94	113	0	8/7/2014	10:00:00	6.13	4491	2.9	6.96	181	0
8/6/2014	10:54:00	4.83	3976	2.5	6.93	113	0	8/7/2014	10:01:00	5.8	4484	2.9	6.97	181	0

8/6/2014	10:55:00	4.8	3963	2.5	6.93	113	0	8/7/2014	10:02:00	5.86	4487	2.9	6.95	181	0
8/6/2014	10:56:00	4.78	3972	2.5	6.94	113	0	8/7/2014	10:03:00	5.93	4477	2.9	6.96	181	0
8/6/2014	10:57:00	4.83	3976	2.5	6.93	113	0	8/7/2014	10:04:00	5.87	4479	2.9	6.96	181	0
8/6/2014	10:58:00	4.83	3976	2.5	6.93	113	0	8/7/2014	10:05:00	5.89	4471	2.9	7.1	181	0
8/6/2014	10:59:00	4.83	3962	2.5	6.93	113	0	8/7/2014	10:06:00	5.87	4475	2.9	6.97	181	0
8/6/2014	11:00:00	4.85	3970	2.5	6.93	113	0	8/7/2014	10:07:00	5.91	4464	2.9	6.99	181	0
8/6/2014	11:01:00	4.88	3972	2.5	6.93	113	0	8/7/2014	10:08:00	5.86	4463	2.9	6.99	181	0
8/6/2014	11:02:00	4.85	3975	2.5	6.94	113	0	8/7/2014	10:09:00	5.92	4459	2.9	6.96	181	0
8/6/2014	11:03:00	4.82	3972	2.5	6.94	113	0	8/7/2014	10:10:00	5.85	4454	2.9	6.92	181	0
8/6/2014	11:04:00	4.85	3971	2.5	7.03	113	0	8/7/2014	10:11:00	5.84	4452	2.8	6.97	181	0
8/6/2014	11:05:00	4.84	3973	2.5	6.94	113	0	8/7/2014	10:12:00	5.89	4447	2.8	6.97	181	0
8/6/2014	11:06:00	4.8	3972	2.5	6.96	113	0	8/7/2014	10:13:00	5.88	4448	2.8	6.96	181	0
8/6/2014	11:07:00	4.83	3978	2.5	6.95	113	0	8/7/2014	10:14:00	5.9	4439	2.8	6.89	181	0
8/6/2014	11:08:00	4.81	3974	2.5	6.72	113	0	8/7/2014	10:15:00	6.12	4430	2.8	6.98	181	0
8/6/2014	11:09:00	4.82	3970	2.5	6.95	113	0	8/7/2014	10:16:00	5.81	4437	2.8	6.96	181	0
8/6/2014	11:10:00	4.87	3969	2.5	6.96	113	0	8/7/2014	10:17:00	5.72	4430	2.8	6.97	181	0
8/6/2014	11:11:00	4.91	3976	2.5	6.96	113	0	8/7/2014	10:18:00	5.74	4422	2.8	6.95	181	0
8/6/2014	11:12:00	4.88	3969	2.5	6.95	113	0	8/7/2014	10:19:00	5.78	4419	2.8	6.98	181	0
8/6/2014	11:13:00	4.85	3970	2.5	6.97	113	0	8/7/2014	10:20:00	5.79	4420	2.8	6.97	181	0
8/6/2014	11:14:00	4.88	3976	2.5	6.96	113	0	8/7/2014	10:21:00	5.8	4421	2.8	6.96	181	0
8/6/2014	11:15:00	4.8	3968	2.5	7	113	0	8/7/2014	10:22:00	5.77	4411	2.8	6.98	181	0
8/6/2014	11:16:00	4.81	3971	2.5	7.01	113	0	8/7/2014	10:23:00	5.85	4415	2.8	6.96	181	0
8/6/2014	11:17:00	4.85	3970	2.5	6.92	113	0	8/7/2014	10:24:00	5.77	4409	2.8	6.97	181	0
8/6/2014	11:18:00	4.81	3969	2.5	6.97	113	0	8/7/2014	10:25:00	5.72	4398	2.8	6.96	181	0
8/6/2014	11:19:00	4.87	3969	2.5	6.96	113	0	8/7/2014	10:26:00	5.73	4399	2.8	6.95	182	0
8/6/2014	11:20:00	4.84	3969	2.5	6.95	113	0	8/7/2014	10:27:00	5.88	4394	2.8	6.97	181	0
8/6/2014	11:21:00	4.87	3971	2.5	6.95	113	0	8/7/2014	10:28:00	5.86	4393	2.8	6.98	182	0
8/6/2014	11:22:00	4.92	3976	2.5	6.96	113	0	8/7/2014	10:29:00	5.76	4387	2.8	6.94	182	0
8/6/2014	11:23:00	6.49	4	0	7.11	123	5.23	8/7/2014	10:30:00	5.97	4371	2.8	6.96	182	0
8/6/2014	11:24:00	6.67	0	0	7.36	123	10.79	8/7/2014	10:31:00	5.81	4378	2.8	7.12	182	0

8/6/2014	11:25:00	7.22	0	0	7.49	124	10.71	8/7/2014	10:32:00	5.84	4378	2.8	6.96	182	0
8/6/2014	11:26:00	7.8	0	0	7.56	124	10.63	8/7/2014	10:33:00	5.84	4375	2.8	7	182	0
8/6/2014	11:27:00	8.35	0	0	7.58	125	10.54	8/7/2014	10:34:00	5.88	4372	2.8	6.98	182	0
8/6/2014	11:28:00	8.86	0	0	7.59	125	10.8	8/7/2014	10:35:00	5.85	4367	2.8	6.96	182	0
8/6/2014	11:29:00	9.36	0	0	7.56	125	10.7	8/7/2014	10:36:00	5.94	4364	2.8	6.99	182	0
8/6/2014	11:30:00	9.83	0	0	7.53	123	10.62	8/7/2014	10:37:00	5.94	4358	2.8	6.97	182	0
8/6/2014	11:31:00	10.27	0	0	7.48	123	10.55	8/7/2014	10:38:00	5.9	4345	2.8	6.97	182	0
8/6/2014	11:32:00	10.69	0	0	7.44	124	10.47	8/7/2014	10:39:00	5.76	4357	2.8	6.97	182	0
8/6/2014	11:33:00	11.08	0	0	7.41	124	10.41	8/7/2014	10:40:00	5.82	4357	2.8	6.97	182	0
8/6/2014	11:34:00	11.45	0	0	7.37	124	10.31	8/7/2014	10:41:00	5.81	4349	2.8	7.01	183	0
8/6/2014	11:35:00	11.8	0	0	7.33	124	10.29	8/7/2014	10:42:00	5.85	4345	2.8	6.97	183	0
8/6/2014	11:36:00	12.17	0	0	7.31	124	10.17	8/7/2014	10:43:00	5.85	4342	2.8	6.94	183	0
8/6/2014	11:37:00	12.52	0	0	7.28	125	10.17	8/7/2014	10:44:00	5.86	4338	2.8	6.96	183	0
8/6/2014	11:38:00	12.86	0	0	7.26	126	10.08	8/7/2014	10:45:00	5.89	4338	2.8	6.95	183	0
8/6/2014	11:39:00	13.19	0	0	7.25	127	10.03	8/7/2014	10:46:00	5.87	4327	2.8	6.99	183	0
8/6/2014	11:40:00	13.5	0	0	7.24	129	10	8/7/2014	10:47:00	5.78	4326	2.8	6.96	183	0
8/6/2014	11:41:00	13.81	0	0	7.22	128	9.95	8/7/2014	10:48:00	5.67	4320	2.8	6.95	183	0
8/6/2014	11:42:00	14.11	0	0	7.21	128	9.89	8/7/2014	10:49:00	5.7	4323	2.8	6.97	183	0
8/6/2014	11:43:00	14.41	0	0	7.21	129	9.85	8/7/2014	10:50:00	5.78	4318	2.8	6.95	183	0
8/6/2014	11:43:00	14.41	0	0	7.21	129	9.85	8/7/2014	10:51:00	5.8	4316	2.8	6.98	183	0
8/6/2014	11:44:00	14.69	0	0	7.21	126	9.81	8/7/2014	10:52:00	5.73	4316	2.8	7.15	183	0
8/6/2014	11:45:00	14.97	0	0	7.21	127	9.8	8/7/2014	10:53:00	5.81	4310	2.8	6.97	183	0
8/6/2014	11:46:00	15.25	0	0	7.2	129	9.73	8/7/2014	10:54:00	5.79	4304	2.8	6.95	183	0
8/6/2014	11:47:00	15.52	0	0	7.19	130	9.68	8/7/2014	10:55:00	5.81	4307	2.8	6.97	183	0
8/6/2014	11:48:00	15.9	4246	2.7	7.96	152	9.75	8/7/2014	10:56:00	5.76	4302	2.8	6.95	184	0
8/6/2014	11:49:00	13.09	5953	3.8	7.82	149	10.86	8/7/2014	10:57:00	5.72	4294	2.7	6.98	184	0
8/6/2014	11:50:00	8.37	5877	3.8	7.86	146	11.48	8/7/2014	10:58:00	5.7	4296	2.7	6.97	184	0
8/6/2014	11:51:00	8.45	5863	3.8	7.88	144	11.58	8/7/2014	10:59:00	5.72	4289	2.7	7.06	184	0
8/6/2014	11:52:00	8.41	5889	3.8	7.86	144	12.09	8/7/2014	11:00:00	6.18	4302	2.8	7.08	183	0
8/6/2014	11:53:00	8.27	5884	3.8	7.91	143	11.92	8/7/2014	11:01:00	5.73	4276	2.7	6.98	184	0

8/6/2014	11:54:00	8.21	5883	3.8	7.9	142	11.77	8/7/2014	11:02:00	5.74	4283	2.7	6.97	184	0
8/6/2014	11:55:00	8.4	5218	3.3	7.92	142	12.71	8/7/2014	11:03:00	5.77	4284	2.7	6.93	184	0
8/6/2014	11:56:00	8.35	5847	3.7	7.97	139	12.89	8/7/2014	11:04:00	5.82	4279	2.7	6.96	184	0
8/6/2014	11:57:00	8.4	5876	3.8	7.96	139	11.15	8/7/2014	11:05:00	5.75	4264	2.7	7.02	184	0
8/6/2014	11:58:00	8.45	5883	3.8	7.97	139	11.03	8/7/2014	11:06:00	5.76	4264	2.7	6.97	184	0
8/6/2014	11:59:00	8.48	5882	3.8	7.99	139	11.07	8/7/2014	11:07:00	5.74	4269	2.7	6.98	184	0
8/6/2014	12:00:00	8.69	5873	3.8	7.97	140	11.07	8/7/2014	11:08:00	5.71	4273	2.7	7.01	184	0
8/6/2014	12:01:00	8.57	5884	3.8	7.98	140	11.06	8/7/2014	11:09:00	5.62	4265	2.7	6.98	184	0
8/6/2014	12:02:00	8.59	5860	3.8	8	140	11.06	8/7/2014	11:10:00	5.75	4263	2.7	6.98	184	0
8/6/2014	12:03:00	8.48	5871	3.8	8	140	11.11	8/7/2014	11:11:00	5.61	4263	2.7	6.99	184	0
8/6/2014	12:04:00	8.56	5875	3.8	8.02	140	11.09	8/7/2014	11:12:00	5.64	4261	2.7	6.98	185	0
8/6/2014	12:05:00	8.69	5873	3.8	8.02	140	11.07	8/7/2014	11:13:00	5.67	4257	2.7	6.95	185	0
8/6/2014	12:06:00	8.67	5883	3.8	8.03	141	11.08	8/7/2014	11:14:00	5.72	4257	2.7	6.98	185	0
8/6/2014	12:07:00	8.79	5881	3.8	8.03	141	11.06	8/7/2014	11:15:00	6.03	4243	2.7	6.97	185	0
8/6/2014	12:08:00	8.83	5873	3.8	8.01	141	11.04	8/7/2014	11:16:00	5.66	4250	2.7	6.99	185	0
8/6/2014	12:09:00	8.86	5870	3.8	7.96	141	11.06	8/7/2014	11:17:00	5.6	4246	2.7	6.98	185	0
8/6/2014	12:10:00	8.8	5872	3.8	8.04	141	11.07	8/7/2014	11:18:00	5.61	4242	2.7	7	185	0
8/6/2014	12:11:00	9	5874	3.8	8.08	141	11.04	8/7/2014	11:19:00	5.6	4236	2.7	6.99	185	0
8/6/2014	12:12:00	8.97	5872	3.8	8.05	142	11.06	8/7/2014	11:20:00	5.66	4233	2.7	6.98	185	0
8/6/2014	12:13:00	8.92	5879	3.8	8.08	142	11.05	8/7/2014	11:21:00	5.68	4226	2.7	6.99	185	0
8/6/2014	12:14:00	8.95	5873	3.8	8.09	142	11.03	8/7/2014	11:22:00	5.75	4235	2.7	6.99	185	0
8/6/2014	12:15:00	9.09	5881	3.8	8.07	142	11.04	8/7/2014	11:23:00	5.64	4236	2.7	6.99	185	0
8/6/2014	12:16:00	9	5869	3.8	8.1	142	11.04	8/7/2014	11:24:00	5.65	4225	2.7	6.99	185	0
8/6/2014	12:17:00	9.09	5882	3.8	8.1	142	11.05	8/7/2014	11:25:00	5.78	4221	2.7	6.98	186	0
8/6/2014	12:18:00	9.15	5879	3.8	8.1	142	11.01	8/7/2014	11:26:00	5.59	4214	2.7	6.98	186	0
8/6/2014	12:19:00	9.17	5872	3.8	8.14	143	11.03	8/7/2014	11:27:00	5.6	4219	2.7	6.98	186	0
8/6/2014	12:20:00	9.3	5869	3.8	8.1	143	11.01	8/7/2014	11:28:00	5.69	4216	2.7	6.98	186	0
8/6/2014	12:21:00	9.25	5867	3.8	8.12	143	11.03	8/7/2014	11:29:00	5.6	4212	2.7	6.96	186	0
8/6/2014	12:22:00	9.09	5878	3.8	8.13	143	11.02	8/7/2014	11:30:00	5.92	4215	2.7	6.99	186	0
8/6/2014	12:23:00	9.1	5876	3.8	8.18	143	10.98	8/7/2014	11:31:00	5.79	4210	2.7	6.98	186	0

8/6/2014	12:24:00	9.15	5871	3.8	8.15	143	10.98	8/7/2014	11:32:00	5.73	4210	2.7	6.84	186	0
8/6/2014	12:25:00	9.26	5878	3.8	8.17	144	10.97	8/7/2014	11:33:00	5.73	4208	2.7	7	186	0
8/6/2014	12:26:00	9.34	5877	3.8	8.22	144	10.96	8/7/2014	11:34:00	5.68	4211	2.7	6.98	186	0
8/6/2014	12:27:00	9.37	5877	3.8	8.2	144	10.95	8/7/2014	11:35:00	5.64	4199	2.7	6.99	186	0
8/6/2014	12:28:00	9.3	5877	3.8	8.16	144	10.96	8/7/2014	11:36:00	5.74	4202	2.7	6.98	186	0
8/6/2014	12:29:00	9.34	5868	3.8	8.17	144	10.93	8/7/2014	11:37:00	5.64	4205	2.7	6.85	187	0
8/6/2014	12:30:00	9.57	5878	3.8	8.16	145	10.92	8/7/2014	11:38:00	5.68	4204	2.7	6.98	186	0
8/6/2014	12:31:00	9.65	5869	3.8	8.19	145	10.92	8/7/2014	11:39:00	5.63	4198	2.7	7.04	187	0
8/6/2014	12:32:00	9.68	5866	3.8	8.2	145	10.91	8/7/2014	11:40:00	5.73	4197	2.7	6.98	187	0
8/6/2014	12:33:00	9.56	5868	3.8	8.21	145	10.92	8/7/2014	11:41:00	5.74	4197	2.7	6.96	187	0
8/6/2014	12:34:00	9.57	5878	3.8	8.2	145	10.9	8/7/2014	11:42:00	5.77	4197	2.7	6.99	187	0
8/6/2014	12:35:00	9.61	5869	3.8	8.2	146	10.88	8/7/2014	11:43:00	5.72	4181	2.7	6.98	187	0
8/6/2014	12:36:00	9.57	5873	3.8	8.18	146	10.89	8/7/2014	11:44:00	5.68	4190	2.7	7	187	0
8/6/2014	12:37:00	9.68	5876	3.8	8.23	146	10.87	8/7/2014	11:45:00	5.95	4184	2.7	6.96	187	0
8/6/2014	12:38:00	9.62	5875	3.8	8.22	146	10.87	8/7/2014	11:46:00	5.54	4189	2.7	6.98	187	0
8/6/2014	12:39:00	9.76	5868	3.8	8.23	146	10.85	8/7/2014	11:47:00	5.56	4184	2.7	7	187	0
8/6/2014	12:40:00	9.81	5868	3.8	8.23	146	10.85	8/7/2014	11:48:00	5.68	4187	2.7	6.99	187	0
8/6/2014	12:41:00	9.87	5873	3.8	8.24	146	10.83	8/7/2014	11:49:00	5.73	4183	2.7	6.97	187	0
8/6/2014	12:42:00	9.75	5876	3.8	8.25	147	10.83	8/7/2014	11:50:00	5.67	4177	2.7	6.98	188	0
8/6/2014	12:43:00	9.93	5874	3.8	8.26	147	10.84	8/7/2014	11:51:00	5.73	4177	2.7	6.98	188	0
8/6/2014	12:44:00	9.93	5875	3.8	8.26	147	10.8	8/7/2014	11:52:00	5.55	4175	2.7	6.98	188	0
8/6/2014	12:45:00	10.01	5874	3.8	8.26	147	10.79	8/7/2014	11:53:00	5.61	4183	2.7	6.97	188	0
8/6/2014	12:46:00	9.94	5854	3.7	8.27	147	10.76	8/7/2014	11:54:00	5.72	4180	2.7	7	188	0
8/6/2014	12:47:00	10.05	5873	3.8	8.27	147	10.77	8/7/2014	11:55:00	5.67	4172	2.7	7.01	188	0
8/6/2014	12:48:00	9.87	5863	3.8	8.27	148	10.76	8/7/2014	11:56:00	5.77	4169	2.7	7	188	0
8/6/2014	12:49:00	10.09	5875	3.8	8.27	148	10.73	8/7/2014	11:57:00	5.6	4166	2.7	7	188	0
8/6/2014	12:50:00	10.22	5873	3.8	8.28	148	10.71	8/7/2014	11:58:00	5.64	4175	2.7	6.98	188	0
8/6/2014	12:51:00	10.29	5875	3.8	8.28	148	10.71	8/7/2014	11:59:00	5.69	4173	2.7	7	188	0
8/6/2014	12:52:00	10.26	5849	3.7	8.45	148	10.7	8/7/2014	12:00:00	5.81	4154	2.7	6.91	188	0
8/6/2014	12:53:00	10.09	5874	3.8	8.3	148	10.68	8/7/2014	12:01:00	5.77	4169	2.7	6.99	188	0

8/6/2014	12:54:00	10.21	5855	3.7	8.32	148	10.69	8/7/2014	12:02:00	5.64	4158	2.7	6.99	188	0
8/6/2014	12:55:00	10.33	5862	3.8	8.29	149	10.68	8/7/2014	12:03:00	5.69	4159	2.7	7.01	188	0
8/6/2014	12:56:00	10.24	5849	3.7	8.3	149	10.67	8/7/2014	12:04:00	5.73	4158	2.7	6.99	188	0
8/6/2014	12:57:00	10.52	5871	3.8	8.32	149	10.64	8/7/2014	12:05:00	5.67	4165	2.7	6.96	189	0
8/6/2014	12:58:00	10.35	5864	3.8	8.32	149	10.66	8/7/2014	12:06:00	5.67	4149	2.7	6.99	189	0
8/6/2014	12:59:00	10.44	5865	3.8	8.33	149	10.64	8/7/2014	12:07:00	5.6	4147	2.7	7.05	189	0
8/6/2014	13:00:00	10.54	5861	3.8	8.31	149	10.63	8/7/2014	12:08:00	5.63	4156	2.7	7	189	0
8/6/2014	13:01:00	10.62	5851	3.7	8.36	150	10.58	8/7/2014	12:09:00	5.62	4149	2.7	7	189	0
8/6/2014	13:02:00	10.56	5871	3.8	8.33	150	10.59	8/7/2014	12:10:00	5.73	4152	2.7	7	189	0
8/6/2014	13:03:00	10.52	5850	3.7	8.35	150	10.58	8/7/2014	12:11:00	5.76	4153	2.7	7.01	189	0
8/6/2014	13:04:00	10.64	5861	3.8	8.33	150	10.54	8/7/2014	12:12:00	5.74	4152	2.7	7.05	189	0
8/6/2014	13:05:00	10.7	5872	3.8	8.36	150	10.55	8/7/2014	12:13:00	5.67	4151	2.7	6.99	189	0
8/6/2014	13:06:00	10.78	5873	3.8	8.34	151	10.53	8/7/2014	12:14:00	5.84	4150	2.7	6.95	189	0
8/6/2014	13:07:00	10.82	5871	3.8	8.35	151	10.52	8/7/2014	12:15:00	5.95	4141	2.7	6.91	189	0
8/6/2014	13:08:00	10.72	5869	3.8	8.36	151	10.52	8/7/2014	12:16:00	5.65	4150	2.7	6.99	189	0
8/6/2014	13:09:00	10.78	5872	3.8	8.36	151	10.53	8/7/2014	12:17:00	5.64	4143	2.7	7	189	0
8/6/2014	13:10:00	10.91	5864	3.8	8.36	151	10.47	8/7/2014	12:18:00	5.72	4150	2.7	7.01	189	0
8/6/2014	13:11:00	11.17	5872	3.8	8.36	151	10.46	8/7/2014	12:19:00	5.8	4145	2.7	7.01	189	0
8/6/2014	13:12:00	11.13	5873	3.8	8.38	152	10.44	8/7/2014	12:20:00	5.8	4146	2.7	7.01	190	0
8/6/2014	13:13:00	11.15	5862	3.8	8.38	152	10.42	8/7/2014	12:21:00	5.71	4138	2.6	7.03	190	0
8/6/2014	13:14:00	11.25	5863	3.8	8.31	152	10.4	8/7/2014	12:22:00	5.68	4139	2.6	7	190	0
8/6/2014	13:15:00	11.26	5871	3.8	8.38	152	10.39	8/7/2014	12:23:00	5.66	4139	2.6	7	190	0
8/6/2014	13:16:00	11.36	5859	3.8	8.38	152	10.42	8/7/2014	12:24:00	5.59	4141	2.7	7.03	190	0
8/6/2014	13:17:00	11.29	5859	3.8	8.41	152	10.38	8/7/2014	12:25:00	5.78	4135	2.6	7	190	0
8/6/2014	13:18:00	11.29	5852	3.7	8.4	153	10.36	8/7/2014	12:26:00	5.65	4140	2.6	7.01	190	0
8/6/2014	13:19:00	11.48	5868	3.8	8.38	153	10.36	8/7/2014	12:27:00	5.59	4137	2.6	7	190	0
8/6/2014	13:20:00	11.68	5862	3.8	8.4	153	10.34	8/7/2014	12:28:00	5.65	4129	2.6	6.98	190	0
8/6/2014	13:21:00	11.56	5860	3.8	8.38	153	10.33	8/7/2014	12:29:00	5.71	4134	2.6	7.01	190	0
8/6/2014	13:22:00	11.53	5870	3.8	8.42	153	10.28	8/7/2014	12:30:00	5.79	4128	2.6	6.99	190	0
8/6/2014	13:23:00	11.99	5713	3.7	8.4	160	8.45	8/7/2014	12:31:00	5.76	4130	2.6	7	191	0

8/6/2014	13:24:00	12.47	5873	3.8	8.4	157	8.58	8/7/2014	12:32:00	5.68	4132	2.6	7.01	191	0
8/6/2014	13:25:00	13.02	5878	3.8	8.39	156	8.13	8/7/2014	12:33:00	5.63	4133	2.6	7.24	191	0
8/6/2014	13:26:00	13.52	1	0	8.45	156	8.16	8/7/2014	12:34:00	5.61	4131	2.6	7.01	191	0
8/6/2014	13:27:00	14.1	1	0	8.5	160	8.48	8/7/2014	12:35:00	5.73	4128	2.6	7	191	0
8/6/2014	13:28:00	14.66	1	0	8.52	162	8.55	8/7/2014	12:36:00	5.72	4126	2.6	7	191	0
8/6/2014	13:29:00	15.21	0	0	8.49	163	8.88	8/7/2014	12:37:00	5.61	4131	2.6	7.01	191	0
8/6/2014	13:30:00	15.74	1	0	8.44	162	8.95	8/7/2014	12:38:00	5.66	4132	2.6	7.02	191	0
8/6/2014	13:31:00	16.26	0	0	8.39	161	8.91	8/7/2014	12:39:00	5.62	4129	2.6	6.99	191	0
								8/7/2014	12:40:00	5.77	4126	2.6	7	191	0
								8/7/2014	12:41:00	5.67	4125	2.6	7	191	0
								8/7/2014	12:42:00	5.85	4124	2.6	7	191	0
								8/7/2014	12:43:00	5.55	4123	2.6	7	192	0
								8/7/2014	12:44:00	5.6	4116	2.6	7.01	192	0
								8/7/2014	12:45:00	5.95	4113	2.6	7	192	0
								8/7/2014	12:46:00	5.69	4118	2.6	6.99	192	0
								8/7/2014	12:47:00	5.63	4115	2.6	7.02	192	0
								8/7/2014	12:48:00	5.67	4122	2.6	7.04	192	0
								8/7/2014	12:49:00	5.64	4123	2.6	7.01	192	0
								8/7/2014	12:50:00	5.53	4123	2.6	7.01	192	0
								8/7/2014	12:51:00	5.73	4120	2.6	7.01	192	0
								8/7/2014	12:52:00	5.77	4105	2.6	7.01	192	0
								8/7/2014	12:53:00	5.75	4115	2.6	7.01	192	0
								8/7/2014	12:54:00	5.74	4116	2.6	7.02	192	0
								8/7/2014	12:55:00	5.65	4116	2.6	7.01	193	0
								8/7/2014	12:56:00	5.52	4116	2.6	7.01	193	0
								8/7/2014	12:57:00	5.64	4115	2.6	7.01	193	0
								8/7/2014	12:58:00	5.65	4106	2.6	7.01	193	0
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								8/7/2014	13:00:00	5.67	4113	2.6	7.01	193	0
								8/7/2014	13:01:00	5.56	4118	2.6	7.01	193	0

								8/7/2014	13:02:00	5.55	4110	2.6	7.01	193	0		
								8/7/2014	13:03:00	5.67	4108	2.6	7.01	193	0		
								8/7/2014	13:04:00	5.64	4110	2.6	7	193	0		
								8/7/2014	13:05:00	5.76	4110	2.6	7.01	193	0		
								8/7/2014	13:06:00	5.78	4108	2.6	7.01	193	0		
								8/7/2014	13:07:00	5.59	4110	2.6	7.01	194	0		
								8/7/2014	13:08:00	5.73	4107	2.6	7.01	194	0		
								8/7/2014	13:09:00	5.55	4109	2.6	7.01	194	0		
								8/7/2014	13:10:00	5.64	4103	2.6	7.02	194	0		
								8/7/2014	13:11:00	5.68	4106	2.6	7.02	194	0		
								8/7/2014	13:12:00	5.59	4094	2.6	7.01	194	0		
								8/7/2014	13:13:00	5.66	4103	2.6	7.02	194	0		
								8/7/2014	13:14:00	5.71	4099	2.6	7	194	0		
								8/7/2014	13:15:00	5.78	4094	2.6	7	194	0		
								8/7/2014	13:16:00	5.67	4099	2.6	7.01	194	0		
								8/7/2014	13:17:00	5.47	4091	2.6	7.01	194	0		
								8/7/2014	13:18:00	5.55	4102	2.6	7.04	194	0		
								8/7/2014	13:19:00	5.58	4103	2.6	7.03	194	0		
								8/7/2014	13:20:00	5.42	4094	2.6	7.05	194	0		
								8/7/2014	13:21:00	5.41	4100	2.6	7.07	194	0		
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								8/7/2014	13:24:00	5.43	4100	2.6	6.99	194	0		
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								8/7/2014	13:26:00	5.57	4092	2.6	7.03	194	0		
								8/7/2014	13:27:00	5.4	4091	2.6	7.02	194	0		
								8/7/2014	13:28:00	5.59	4096	2.6	7.02	194	0		
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								8/7/2014	13:30:00	5.43	4090	2.6	7.02	195	0		
								8/7/2014	13:31:00	5.51	4094	2.6	6.94	195	0		

								8/7/2014	13:32:00	5.53	4089	2.6	7	195	0
								8/7/2014	13:33:00	5.49	4087	2.6	6.99	195	0
								8/7/2014	13:34:00	5.61	4087	2.6	7.01	195	0
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								8/7/2014	13:36:00	5.67	4082	2.6	7.02	195	0
								8/7/2014	13:37:00	5.6	4088	2.6	6.98	195	0
								8/7/2014	13:38:00	5.5	4091	2.6	7.03	195	0
								8/7/2014	13:39:00	5.63	4087	2.6	7.03	195	0
								8/7/2014	13:40:00	5.51	4091	2.6	7.04	195	0
								8/7/2014	13:41:00	5.53	4090	2.6	7.02	196	0
								8/7/2014	13:42:00	5.56	4084	2.6	7.03	196	0
								8/7/2014	13:43:00	5.5	4089	2.6	7.03	196	0
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								8/7/2014	13:47:00	5.69	4081	2.6	7.05	196	0
								8/7/2014	13:48:00	5.53	4081	2.6	7.15	196	0
								8/7/2014	13:49:00	5.64	4083	2.6	7.06	196	0
								8/7/2014	13:50:00	5.7	4083	2.6	7.04	196	0
								8/7/2014	13:51:00	5.49	4082	2.6	7.08	196	0
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								8/7/2014	13:54:00	5.61	4086	2.6	6.97	197	0
								8/7/2014	13:55:00	5.61	4079	2.6	7	197	0
								8/7/2014	13:56:00	5.71	4083	2.6	6.99	197	0
								8/7/2014	13:57:00	5.85	4078	2.6	7	197	0
								8/7/2014	13:58:00	5.78	4079	2.6	7.02	198	0
								8/7/2014	13:59:00	5.79	4085	2.6	7.03	198	0
								8/7/2014	14:00:00	5.68	4079	2.6	7.02	198	0
								8/7/2014	14:01:00	5.62	4075	2.6	7.1	198	0

								8/7/2014	14:02:00	5.48	4085	2.6	7.06	198	0
								8/7/2014	14:03:00	5.55	4081	2.6	7.06	198	0
								8/7/2014	14:04:00	5.59	4076	2.6	7.04	198	0
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								8/7/2014	14:06:00	5.48	4080	2.6	7.04	198	0
								8/7/2014	14:07:00	5.63	4075	2.6	7.03	198	0
								8/7/2014	14:08:00	5.53	4066	2.6	7.03	198	0
								8/7/2014	14:09:00	5.61	4077	2.6	7.03	198	0
								8/7/2014	14:10:00	5.65	4070	2.6	7.03	199	0
								8/7/2014	14:11:00	5.53	4076	2.6	7.03	199	0
								8/7/2014	14:12:00	5.39	4079	2.6	7.06	199	0
								8/7/2014	14:13:00	5.64	4077	2.6	7.03	199	0
								8/7/2014	14:14:00	5.95	4075	2.6	7.04	199	0
								8/7/2014	14:15:00	6.07	4070	2.6	7.11	199	0
								8/7/2014	14:16:00	5.81	4056	2.6	7.1	199	0
								8/7/2014	14:17:00	5.33	4071	2.6	7.13	199	0
								8/7/2014	14:18:00	5.33	4074	2.6	7.11	198	0
								8/7/2014	14:19:00	5.41	4070	2.6	7.08	198	0
								8/7/2014	14:20:00	5.38	4076	2.6	7.07	198	0
								8/7/2014	14:21:00	5.35	4069	2.6	7.05	198	0
								8/7/2014	14:22:00	5.44	4074	2.6	7.05	198	0
								8/7/2014	14:23:00	5.55	4071	2.6	7.04	198	0
								8/7/2014	14:24:00	5.52	4065	2.6	7.08	198	0
								8/7/2014	14:25:00	5.57	4066	2.6	7.05	198	0
								8/7/2014	14:26:00	5.55	4069	2.6	7.05	198	0
								8/7/2014	14:27:00	5.55	4067	2.6	7.04	198	0
								8/7/2014	14:28:00	5.54	4066	2.6	7.04	198	0
								8/7/2014	14:29:00	5.49	4067	2.6	7.04	198	0
								8/7/2014	14:30:00	5.41	4073	2.6	7.16	198	0
								8/7/2014	14:31:00	5.6	4069	2.6	7.03	198	0

								8/7/2014	14:32:00	5.42	4066	2.6	7.06	198	0
								8/7/2014	14:33:00	5.55	4069	2.6	7.04	198	0
								8/7/2014	14:34:00	5.47	4065	2.6	7.04	198	0
								8/7/2014	14:35:00	5.47	4063	2.6	7.04	199	0
								8/7/2014	14:36:00	5.63	4070	2.6	7.09	198	0
								8/7/2014	14:37:00	5.58	4068	2.6	7.08	199	0
								8/7/2014	14:38:00	5.61	4070	2.6	7.09	199	0
								8/7/2014	14:39:00	5.53	4067	2.6	7.07	199	0
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								8/7/2014	14:42:00	5.79	4067	2.6	7.06	199	0
								8/7/2014	14:43:00	5.6	4060	2.6	7.03	199	0
								8/7/2014	14:44:00	5.54	4062	2.6	7.01	199	0
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								8/7/2014	14:46:00	5.4	4059	2.6	7.06	198	0
								8/7/2014	14:47:00	5.46	4066	2.6	7.07	198	0
								8/7/2014	14:48:00	5.57	4066	2.6	7.09	198	0
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								8/7/2014	14:54:00	5.74	4063	2.6	7.02	199	0
								8/7/2014	14:55:00	5.64	4064	2.6	7.01	199	0
								8/7/2014	14:56:00	5.77	4065	2.6	7.01	199	0
								8/7/2014	14:57:00	5.52	4057	2.6	7.02	199	0
								8/7/2014	14:58:00	5.63	4063	2.6	7.02	199	0
								8/7/2014	14:59:00	5.48	4061	2.6	6.98	199	0
								8/7/2014	15:00:00	5.64	4058	2.6	7.01	199	0
								8/7/2014	15:01:00	5.5	4055	2.6	6.99	199	0

								8/7/2014	15:02:00	5.42	4053	2.6	7	199	0
								8/7/2014	15:03:00	5.38	4053	2.6	7.01	199	0
								8/7/2014	15:04:00	5.52	4054	2.6	7.01	199	0
								8/7/2014	15:05:00	5.41	4057	2.6	7.02	199	0
								8/7/2014	15:06:00	5.39	4060	2.6	7.02	199	0
								8/7/2014	15:07:00	5.26	4059	2.6	7.03	199	0
								8/7/2014	15:08:00	5.42	4053	2.6	7.03	199	0
								8/7/2014	15:09:00	5.36	4055	2.6	7.02	199	0
								8/7/2014	15:10:00	5.48	4057	2.6	7.03	199	0
								8/7/2014	15:11:00	5.36	4054	2.6	7.1	199	0
								8/7/2014	15:12:00	5.39	4054	2.6	7.02	199	0
								8/7/2014	15:13:00	5.51	4054	2.6	7.02	199	0
								8/7/2014	15:14:00	5.49	4055	2.6	6.94	199	0
								8/7/2014	15:15:00	5.46	4048	2.6	6.99	199	0
								8/7/2014	15:16:00	5.6	4054	2.6	7.06	199	0
								8/7/2014	15:17:00	5.46	4056	2.6	7.08	199	0
								8/7/2014	15:18:00	5.39	4058	2.6	7.05	199	0
								8/7/2014	15:19:00	5.4	4055	2.6	7.04	199	0
								8/7/2014	15:20:00	5.48	4054	2.6	7.03	199	0
								8/7/2014	15:21:00	5.58	4050	2.6	7.04	199	0
								8/7/2014	15:22:00	5.63	4056	2.6	7.03	199	0
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								8/7/2014	15:25:00	5.51	4052	2.6	7.05	200	0
								8/7/2014	15:26:00	5.4	4054	2.6	7.05	200	0
								8/7/2014	15:27:00	5.48	4054	2.6	7.06	200	0
								8/7/2014	15:28:00	5.42	4054	2.6	7.03	200	0
								8/7/2014	15:29:00	5.44	4053	2.6	6.98	200	0
								8/7/2014	15:30:00	5.5	4057	2.6	7.02	200	0
								8/7/2014	15:31:00	5.65	4047	2.6	7.02	200	0

								8/7/2014	15:32:00	5.56	4040	2.6	7.03	200	0
								8/7/2014	15:33:00	5.64	4049	2.6	7.03	200	0
								8/7/2014	15:34:00	5.47	4050	2.6	7.03	200	0
								8/7/2014	15:35:00	5.5	4046	2.6	7.03	200	0
								8/7/2014	15:36:00	5.57	4051	2.6	7.03	200	0
								8/7/2014	15:37:00	5.54	4049	2.6	7.03	201	0
								8/7/2014	15:38:00	5.58	4053	2.6	7.03	201	0
								8/7/2014	15:39:00	5.54	4041	2.6	7.03	201	0
								8/7/2014	15:40:00	5.64	4050	2.6	7.01	201	0
								8/7/2014	15:41:00	5.66	4051	2.6	7.04	201	0
								8/7/2014	15:42:00	5.73	4047	2.6	7.03	201	0
								8/7/2014	15:43:00	5.57	4043	2.6	6.86	201	0
								8/7/2014	15:44:00	5.59	4049	2.6	6.91	201	0
								8/7/2014	15:45:00	5.68	4046	2.6	6.99	201	0
								8/7/2014	15:46:00	5.57	4048	2.6	6.98	201	0
								8/7/2014	15:47:00	5.42	4043	2.6	6.98	201	0
								8/7/2014	15:48:00	5.47	4052	2.6	7.04	201	0
								8/7/2014	15:49:00	5.38	4049	2.6	7.04	201	0
								8/7/2014	15:50:00	5.37	4046	2.6	6.91	201	0
								8/7/2014	15:51:00	5.46	4043	2.6	7.05	201	0
								8/7/2014	15:52:00	5.36	4050	2.6	6.99	201	0
								8/7/2014	15:53:00	5.5	4049	2.6	7.02	201	0
								8/7/2014	15:54:00	5.45	4050	2.6	7.04	201	0
								8/7/2014	15:55:00	5.57	4047	2.6	7.04	200	0
								8/7/2014	15:56:00	5.43	4045	2.6	7.05	200	0
								8/7/2014	15:57:00	5.5	4048	2.6	7.16	199	0
								8/7/2014	15:58:00	5.59	4043	2.6	7.19	199	0
								8/7/2014	15:59:00	5.45	4049	2.6	7.16	199	0
								8/7/2014	16:00:00	5.44	4050	2.6	7.07	199	0
								8/7/2014	16:01:00	5.49	4035	2.6	7.1	198	0

								8/7/2014	16:02:00	5.46	4044	2.6	7.09	198	0
								8/7/2014	16:03:00	5.51	4043	2.6	7.05	198	0
								8/7/2014	16:04:00	5.42	4043	2.6	7.09	198	0
								8/7/2014	16:05:00	5.56	4041	2.6	7	198	0
								8/7/2014	16:06:00	5.52	4042	2.6	7.07	198	0
								8/7/2014	16:07:00	5.56	4035	2.6	7.06	198	0
								8/7/2014	16:08:00	5.66	4049	2.6	7.05	198	0
								8/7/2014	16:09:00	5.68	4041	2.6	7.04	198	0
								8/7/2014	16:10:00	5.56	4041	2.6	7.05	198	0
								8/7/2014	16:11:00	5.7	4047	2.6	7.05	198	0
								8/7/2014	16:12:00	5.78	4048	2.6	6.95	198	0
								8/7/2014	16:13:00	5.62	4044	2.6	7.03	198	0
								8/7/2014	16:14:00	6.26	4053	2.6	6.89	198	0
								8/7/2014	16:15:00	5.53	4043	2.6	7.05	198	0
								8/7/2014	16:16:00	5.42	4047	2.6	7	198	0
								8/7/2014	16:17:00	7.55	2	0	7.07	206	0.87
								8/7/2014	16:18:00	8.6	0	0	6.99	205	0.57
								8/7/2014	16:19:00	9.66	0	0	7.02	205	0.55
								8/7/2014	16:20:00	10.59	0	0	7.09	205	0.65
								8/7/2014	16:21:00	11.46	0	0	7.05	205	0.84
								8/7/2014	16:22:00	12.27	0	0	7.04	204	0.86

Table C10. Hydrolab data for push-pull test 2 conducted at well 1D in 2014.

INJECTION								EXTRACTION							
Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)	Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)
8/15/2014	7:57:00	15.01	0	0	7.01	383	8.53	8/18/2014	7:41:00	12.57	0	0	6.98	480	8.96
8/15/2014	7:58:00	14.92	0	0	7.04	384	8.56	8/18/2014	7:42:00	12.6	0	0	7.11	478	8.97
8/15/2014	7:59:00	14.83	0	0	7.08	386	8.56	8/18/2014	7:43:00	12.6	0	0	7.17	477	8.96
8/15/2014	8:00:00	14.74	0	0	7.08	386	8.59	8/18/2014	7:44:00	12.59	0	0	7.21	476	8.96
8/15/2014	8:01:00	14.66	0	0	7.09	387	8.59	8/18/2014	7:45:00	12.57	0	0	7.23	474	8.96
8/15/2014	8:02:00	14.58	0	0	7.1	388	8.63	8/18/2014	7:46:00	12.54	0	0	7.24	474	8.95
8/15/2014	8:03:00	14.51	0	0	7.11	389	8.64	8/18/2014	7:47:00	12.45	0	0	7.27	473	8.96
8/15/2014	8:04:00	14.44	0	0	7.12	390	8.64	8/18/2014	7:48:00	12.43	0	0	7.28	472	9.03
8/15/2014	8:05:00	14.37	0	0	7.12	395	8.66	8/18/2014	7:49:00	12.39	0	0	7.29	469	9.01
8/15/2014	8:06:00	14.31	0	0	7.13	392	8.65	8/18/2014	7:50:00	12.35	0	0	7.3	471	9
8/15/2014	8:07:00	14.25	0	0	7.12	393	8.66	8/18/2014	7:51:00	12.31	0	0	7.3	470	9.01
8/15/2014	8:08:00	14.2	0	0	7.14	394	8.71	8/18/2014	7:52:00	12.27	0	0	7.31	470	9.07
8/15/2014	8:09:00	14.14	0	0	7.14	394	8.71	8/18/2014	7:53:00	12.23	0	0	7.32	468	9.04
8/15/2014	8:10:00	14.08	0	0	7.14	395	8.74	8/18/2014	7:54:00	12.2	0	0	7.32	468	9.08
8/15/2014	8:11:00	14.03	0	0	7.15	397	8.76	8/18/2014	7:55:00	12.16	0	0	7.34	467	9.12
8/15/2014	8:12:00	13.98	0	0	7.16	396	8.76	8/18/2014	7:56:00	12.12	0	0	7.33	467	9.11
8/15/2014	8:13:00	13.94	0	0	7.08	395	8.77	8/18/2014	7:57:00	12.09	0	0	7.34	465	9.12
8/15/2014	8:14:00	5.91	3831	2.5	6.95	409	8.93	8/18/2014	7:58:00	12.06	0	0	7.35	466	9.16
8/15/2014	8:15:00	4.26	4116	2.6	6.86	396	1.14	8/18/2014	7:59:00	12.04	0	0	7.35	466	9.17
8/15/2014	8:16:00	4.68	4117	2.6	6.84	392	0	8/18/2014	8:00:00	12.01	0	0	7.36	466	9.18
8/15/2014	8:17:00	4.81	4110	2.6	6.83	389	0	8/18/2014	8:01:00	11.99	0	0	7.36	466	9.16
8/15/2014	8:18:00	4.89	4107	2.6	6.83	388	0	8/18/2014	8:02:00	11.97	0	0	7.36	464	9.18
8/15/2014	8:19:00	4.92	4103	2.6	6.83	387	0	8/18/2014	8:03:00	11.95	0	0	7.37	465	9.21
8/15/2014	8:20:00	4.97	4099	2.6	6.83	386	0	8/18/2014	8:04:00	11.94	0	0	7.38	464	9.23
8/15/2014	8:21:00	4.88	4095	2.6	6.83	385	0	8/18/2014	8:05:00	11.94	0	0	7.38	462	9.22
8/15/2014	8:22:00	4.88	4090	2.6	6.82	384	0	8/18/2014	8:06:00	11.95	0	0	7.38	464	9.19
8/15/2014	8:23:00	4.87	4089	2.6	6.82	384	0	8/18/2014	8:07:00	11.96	0	0	7.38	463	9.23

8/15/2014	8:24:00	4.87	4080	2.6	6.82	383	0	8/18/2014	8:08:00	11.99	0	0	7.39	462	9.18
8/15/2014	8:25:00	4.87	4075	2.6	6.83	383	0	8/18/2014	8:09:00	12.03	0	0	7.39	462	9.19
8/15/2014	8:26:00	4.88	4074	2.6	6.82	382	0	8/18/2014	8:10:00	12.09	0	0	7.39	463	9.19
8/15/2014	8:27:00	4.91	4064	2.6	6.82	382	0	8/18/2014	8:11:00	12.13	0	0	7.39	462	9.16
8/15/2014	8:28:00	4.92	4057	2.6	6.82	381	0	8/18/2014	8:12:00	12.17	0	0	7.4	462	9.15
8/15/2014	8:29:00	4.92	4050	2.6	6.83	381	0	8/18/2014	8:13:00	12.19	0	0	7.4	461	9.16
8/15/2014	8:30:00	4.83	4041	2.6	6.83	380	0	8/18/2014	8:14:00	7.19	4609	3	7.16	447	6.73
8/15/2014	8:31:00	4.88	4034	2.6	6.83	380	0	8/18/2014	8:15:00	4.81	756	0.5	7.17	455	0.67
8/15/2014	8:32:00	4.9	4034	2.6	6.83	380	0	8/18/2014	8:16:00	4.86	5323	3.4	7.15	445	0.18
8/15/2014	8:33:00	4.88	4026	2.6	6.83	379	0	8/18/2014	8:17:00	5.28	5200	3.3	7.14	443	0
8/15/2014	8:34:00	4.92	4035	2.6	6.84	381	0	8/18/2014	8:18:00	5.42	5109	3.3	7.11	442	0
8/15/2014	8:35:00	4.82	4018	2.6	6.84	380	0	8/18/2014	8:19:00	5.49	5045	3.2	7.08	442	0
8/15/2014	8:36:00	4.91	4023	2.6	6.84	379	0	8/18/2014	8:20:00	5.51	5007	3.2	7.06	442	0
8/15/2014	8:37:00	4.81	4017	2.6	6.85	379	0	8/18/2014	8:21:00	5.51	4973	3.2	7.04	442	0
8/15/2014	8:38:00	4.86	4010	2.6	6.85	378	0	8/18/2014	8:22:00	5.46	4954	3.2	7.03	442	0
8/15/2014	8:39:00	4.87	4009	2.6	6.84	378	0	8/18/2014	8:23:00	5.56	4919	3.1	7.02	441	0
8/15/2014	8:40:00	4.82	4007	2.6	6.84	378	0	8/18/2014	8:24:00	5.55	4906	3.1	7.01	440	0
8/15/2014	8:41:00	4.85	4002	2.6	6.84	378	0	8/18/2014	8:25:00	5.56	4889	3.1	7	440	0
8/15/2014	8:42:00	4.87	4003	2.6	6.84	378	0	8/18/2014	8:26:00	5.6	4858	3.1	7	439	0
8/15/2014	8:43:00	4.86	4004	2.6	6.84	378	0	8/18/2014	8:27:00	5.59	4849	3.1	6.99	439	0
8/15/2014	8:44:00	4.82	4003	2.6	6.84	378	0	8/18/2014	8:28:00	5.6	4828	3.1	6.98	439	0
8/15/2014	8:45:00	4.82	3999	2.6	6.84	378	0	8/18/2014	8:29:00	5.59	4810	3.1	6.97	439	0
8/15/2014	8:46:00	4.8	3988	2.6	6.83	377	0	8/18/2014	8:30:00	5.56	4795	3.1	6.97	438	0
8/15/2014	8:47:00	4.81	4000	2.6	6.83	378	0	8/18/2014	8:31:00	5.55	4783	3.1	6.96	438	0
8/15/2014	8:48:00	4.81	3998	2.6	6.83	377	0	8/18/2014	8:32:00	5.48	4785	3.1	6.96	438	0
8/15/2014	8:49:00	4.83	3992	2.6	6.84	377	0	8/18/2014	8:33:00	5.51	4760	3	6.95	437	0
8/15/2014	8:50:00	4.85	3989	2.6	6.83	377	0	8/18/2014	8:34:00	5.52	4748	3	6.95	437	0
8/15/2014	8:51:00	4.84	3988	2.6	6.83	377	0	8/18/2014	8:35:00	5.5	4738	3	6.95	437	0
8/15/2014	8:52:00	4.83	3986	2.6	6.83	377	0	8/18/2014	8:36:00	5.5	4724	3	6.95	436	0
8/15/2014	8:53:00	4.83	3984	2.5	6.83	377	0	8/18/2014	8:37:00	5.49	4719	3	6.94	436	0

8/15/2014	8:54:00	4.84	3989	2.6	6.83	377	0	8/18/2014	8:38:00	5.51	4703	3	6.94	436	0
8/15/2014	8:55:00	4.86	3981	2.5	6.83	377	0	8/18/2014	8:39:00	5.51	4702	3	6.94	435	0
8/15/2014	8:56:00	4.83	3987	2.6	6.83	376	0	8/18/2014	8:40:00	5.49	4665	3	6.94	435	0
8/15/2014	8:57:00	4.83	3980	2.5	6.83	376	0	8/18/2014	8:41:00	5.49	4667	3	6.94	435	0
8/15/2014	8:58:00	4.83	3980	2.5	6.84	376	0	8/18/2014	8:42:00	5.5	4648	3	6.94	434	0
8/15/2014	8:59:00	4.83	3988	2.6	6.83	376	0	8/18/2014	8:43:00	5.47	4642	3	6.94	434	0
8/15/2014	9:00:00	4.82	3975	2.5	6.83	376	0	8/18/2014	8:44:00	5.48	4643	3	6.94	434	0
8/15/2014	9:01:00	4.82	3983	2.5	6.83	376	0	8/18/2014	8:45:00	5.51	4616	3	6.93	434	0
8/15/2014	9:02:00	4.84	3981	2.5	6.83	376	0	8/18/2014	8:46:00	5.43	4607	2.9	6.93	433	0
8/15/2014	9:03:00	4.84	3974	2.5	6.83	376	0	8/18/2014	8:47:00	5.36	4607	2.9	6.93	433	0
8/15/2014	9:04:00	4.81	3970	2.5	6.83	376	0	8/18/2014	8:48:00	5.42	4584	2.9	6.92	433	0
8/15/2014	9:05:00	4.82	3975	2.5	6.83	376	0	8/18/2014	8:49:00	5.43	4562	2.9	6.92	432	0
8/15/2014	9:06:00	4.8	3972	2.5	6.83	376	0	8/18/2014	8:50:00	5.43	4567	2.9	6.92	432	0
8/15/2014	9:07:00	4.82	3971	2.5	6.83	376	0	8/18/2014	8:51:00	5.45	4565	2.9	6.92	432	0
8/15/2014	9:08:00	4.83	3971	2.5	6.83	376	0	8/18/2014	8:52:00	5.46	4540	2.9	6.92	432	0
8/15/2014	9:09:00	4.91	3969	2.5	6.83	376	0	8/18/2014	8:53:00	5.45	4545	2.9	6.92	431	0
8/15/2014	9:10:00	4.83	3959	2.5	6.83	376	0	8/18/2014	8:54:00	5.46	4538	2.9	6.92	431	0
8/15/2014	9:11:00	4.68	3967	2.5	6.83	376	0	8/18/2014	8:55:00	5.46	4529	2.9	6.92	431	0
8/15/2014	9:12:00	4.72	3959	2.5	6.83	376	0	8/18/2014	8:56:00	5.43	4522	2.9	6.92	431	0
8/15/2014	9:13:00	4.74	3965	2.5	6.83	376	0	8/18/2014	8:57:00	5.43	4513	2.9	6.91	430	0
8/15/2014	9:14:00	4.81	3967	2.5	6.83	376	0	8/18/2014	8:58:00	5.45	4516	2.9	6.92	430	0
8/15/2014	9:15:00	4.77	3965	2.5	6.83	376	0	8/18/2014	8:59:00	5.42	4506	2.9	6.91	430	0
8/15/2014	9:16:00	4.82	3959	2.5	6.83	376	0	8/18/2014	9:00:00	5.41	4499	2.9	6.91	430	0
8/15/2014	9:17:00	4.79	3967	2.5	6.83	375	0	8/18/2014	9:01:00	5.37	4511	2.9	6.91	429	0
8/15/2014	9:18:00	4.79	3962	2.5	6.83	375	0	8/18/2014	9:02:00	5.36	4494	2.9	6.91	429	0
8/15/2014	9:19:00	4.78	3962	2.5	6.83	377	0	8/18/2014	9:03:00	5.44	4477	2.9	6.91	429	0
8/15/2014	9:20:00	4.74	3962	2.5	6.83	375	0	8/18/2014	9:04:00	5.42	4493	2.9	6.91	429	0
8/15/2014	9:21:00	4.72	3965	2.5	6.83	375	0	8/18/2014	9:05:00	5.43	4481	2.9	6.91	429	0
8/15/2014	9:22:00	4.73	3958	2.5	6.84	375	0	8/18/2014	9:06:00	5.45	4482	2.9	6.91	428	0
8/15/2014	9:23:00	4.76	3977	2.5	6.84	375	0	8/18/2014	9:07:00	5.44	4465	2.9	6.9	428	0

8/15/2014	9:24:00	4.81	3949	2.5	6.84	375	0	8/18/2014	9:08:00	5.47	4452	2.8	6.9	428	0
8/15/2014	9:25:00	4.65	3955	2.5	6.84	375	0	8/18/2014	9:09:00	5.47	4471	2.9	6.91	428	0
8/15/2014	9:26:00	4.77	3958	2.5	6.84	375	0	8/18/2014	9:10:00	5.49	4459	2.9	6.9	427	0
8/15/2014	9:27:00	4.75	3951	2.5	6.84	375	0	8/18/2014	9:11:00	5.48	4454	2.9	6.9	427	0
8/15/2014	9:28:00	4.85	3949	2.5	6.84	377	0	8/18/2014	9:12:00	5.49	4455	2.9	6.91	427	0
8/15/2014	9:29:00	4.65	3936	2.5	6.84	375	0	8/18/2014	9:13:00	5.55	4449	2.8	6.9	427	0
8/15/2014	9:30:00	4.7	3951	2.5	6.84	375	0	8/18/2014	9:14:00	5.49	4444	2.8	6.9	427	0
8/15/2014	9:31:00	4.74	3957	2.5	6.85	376	0	8/18/2014	9:15:00	5.48	4445	2.8	6.9	426	0
8/15/2014	9:32:00	4.79	3939	2.5	6.84	375	0	8/18/2014	9:16:00	5.45	4438	2.8	6.9	426	0
8/15/2014	9:33:00	4.68	3943	2.5	6.85	375	0	8/18/2014	9:17:00	5.39	4434	2.8	6.9	426	0
8/15/2014	9:34:00	4.76	3949	2.5	6.85	375	0	8/18/2014	9:18:00	5.47	4430	2.8	6.9	426	0
8/15/2014	9:35:00	4.78	3951	2.5	6.85	375	0	8/18/2014	9:19:00	5.47	4419	2.8	6.9	426	0
8/15/2014	9:36:00	4.88	3943	2.5	6.85	375	0	8/18/2014	9:20:00	5.47	4411	2.8	6.9	425	0
8/15/2014	9:37:00	4.67	3942	2.5	6.85	375	0	8/18/2014	9:21:00	5.47	4419	2.8	6.9	425	0
8/15/2014	9:38:00	4.74	3946	2.5	6.85	375	0	8/18/2014	9:22:00	5.46	4410	2.8	6.9	425	0
8/15/2014	9:39:00	4.76	3956	2.5	6.85	375	0	8/18/2014	9:23:00	5.46	4410	2.8	6.89	425	0
8/15/2014	9:40:00	4.79	3948	2.5	6.85	375	0	8/18/2014	9:24:00	5.49	4416	2.8	6.89	424	0
8/15/2014	9:41:00	4.79	3936	2.5	6.85	375	0	8/18/2014	9:25:00	5.48	4408	2.8	6.9	424	0
8/15/2014	9:42:00	4.8	3945	2.5	6.85	375	0	8/18/2014	9:26:00	5.47	4415	2.8	6.9	424	0
8/15/2014	9:43:00	4.79	3947	2.5	6.85	375	0	8/18/2014	9:27:00	5.49	4409	2.8	6.89	423	0
8/15/2014	9:44:00	4.83	3949	2.5	6.86	375	0	8/18/2014	9:28:00	5.49	4410	2.8	6.9	423	0
8/15/2014	9:45:00	4.7	3943	2.5	6.85	375	0	8/18/2014	9:29:00	5.49	4405	2.8	6.89	423	0
8/15/2014	9:46:00	4.75	3944	2.5	6.86	375	0	8/18/2014	9:30:00	5.46	4395	2.8	6.89	423	0
8/15/2014	9:47:00	4.77	3945	2.5	6.86	375	0	8/18/2014	9:31:00	5.33	4405	2.8	6.89	422	0
8/15/2014	9:48:00	4.78	3942	2.5	6.86	375	0	8/18/2014	9:32:00	5.38	4396	2.8	6.89	422	0
8/15/2014	9:49:00	4.84	3933	2.5	6.86	375	0	8/18/2014	9:33:00	5.45	4383	2.8	6.89	422	0
8/15/2014	9:50:00	4.81	3942	2.5	6.86	375	0	8/18/2014	9:34:00	5.45	4387	2.8	6.89	422	0
8/15/2014	9:51:00	4.81	3947	2.5	6.86	375	0	8/18/2014	9:35:00	5.4	4391	2.8	6.89	421	0
8/15/2014	9:52:00	4.75	3946	2.5	6.86	375	0	8/18/2014	9:36:00	5.45	4385	2.8	6.89	421	0
8/15/2014	9:53:00	4.77	3941	2.5	6.86	375	0	8/18/2014	9:37:00	5.44	4388	2.8	6.89	421	0

8/15/2014	9:54:00	4.74	3942	2.5	6.86	375	0	8/18/2014	9:38:00	5.4	4375	2.8	6.89	421	0
8/15/2014	9:55:00	4.74	3939	2.5	6.86	375	0	8/18/2014	9:39:00	5.42	4386	2.8	6.89	420	0
8/15/2014	9:56:00	4.73	3937	2.5	6.91	375	0	8/18/2014	9:40:00	5.45	4371	2.8	6.89	420	0
8/15/2014	9:57:00	4.8	3937	2.5	6.84	375	0	8/18/2014	9:41:00	5.44	4370	2.8	6.89	420	0
8/15/2014	9:58:00	4.75	3946	2.5	6.86	375	0	8/18/2014	9:42:00	5.42	4357	2.8	6.89	420	0
8/15/2014	9:59:00	4.79	3943	2.5	6.86	375	0	8/18/2014	9:43:00	5.42	4374	2.8	6.89	420	0
8/15/2014	10:00:00	4.76	3937	2.5	6.87	375	0	8/18/2014	9:44:00	5.39	4365	2.8	6.9	419	0
8/15/2014	10:01:00	4.78	3935	2.5	6.86	375	0	8/18/2014	9:45:00	5.47	4359	2.8	6.89	419	0
8/15/2014	10:02:00	4.79	3943	2.5	6.86	375	0	8/18/2014	9:46:00	5.31	4357	2.8	6.89	419	0
8/15/2014	10:03:00	4.81	3933	2.5	6.87	375	0	8/18/2014	9:47:00	5.36	4371	2.8	6.89	419	0
8/15/2014	10:04:00	4.81	3934	2.5	6.84	375	0	8/18/2014	9:48:00	5.41	4347	2.8	6.88	419	0
8/15/2014	10:05:00	4.82	3935	2.5	6.86	375	0	8/18/2014	9:49:00	5.45	4347	2.8	6.88	419	0
8/15/2014	10:06:00	4.85	3937	2.5	6.86	375	0	8/18/2014	9:50:00	5.44	4352	2.8	6.88	419	0
8/15/2014	10:07:00	4.83	3935	2.5	6.86	375	0	8/18/2014	9:51:00	5.51	4354	2.8	6.88	419	0
8/15/2014	10:08:00	4.82	3937	2.5	6.86	375	0	8/18/2014	9:52:00	5.46	4346	2.8	6.88	419	0
8/15/2014	10:09:00	4.78	3939	2.5	6.86	375	0	8/18/2014	9:53:00	5.47	4350	2.8	6.88	418	0
8/15/2014	10:10:00	4.81	3944	2.5	6.86	375	0	8/18/2014	9:54:00	5.49	4341	2.8	6.88	418	0
8/15/2014	10:11:00	4.79	3938	2.5	6.86	375	0	8/18/2014	9:55:00	5.52	4338	2.8	6.88	418	0
8/15/2014	10:12:00	4.78	3930	2.5	6.86	375	0	8/18/2014	9:56:00	5.47	4336	2.8	6.88	418	0
8/15/2014	10:13:00	4.79	3919	2.5	6.86	375	0	8/18/2014	9:57:00	5.53	4330	2.8	6.88	418	0
8/15/2014	10:14:00	4.78	3937	2.5	6.86	375	0	8/18/2014	9:58:00	5.55	4333	2.8	6.89	418	0
8/15/2014	10:15:00	4.82	3934	2.5	6.86	375	0	8/18/2014	9:59:00	5.49	4339	2.8	6.88	418	0
8/15/2014	10:16:00	4.83	3924	2.5	6.86	376	0	8/18/2014	10:00:00	5.52	4326	2.8	6.88	418	0
8/15/2014	10:17:00	4.83	3932	2.5	6.86	376	0	8/18/2014	10:01:00	5.43	4341	2.8	6.89	418	0
8/15/2014	10:18:00	4.84	3927	2.5	6.86	376	0	8/18/2014	10:02:00	5.44	4333	2.8	6.88	417	0

8/15/2014	10:19:00	4.84	3928	2.5	6.86	376	0	8/18/2014	10:03:00	5.49	4320	2.8	6.88	417	0
8/15/2014	10:20:00	4.86	3929	2.5	6.86	376	0	8/18/2014	10:04:00	5.51	4321	2.8	6.88	417	0
8/15/2014	10:21:00	4.84	3923	2.5	6.86	376	0	8/18/2014	10:05:00	5.46	4316	2.8	6.88	417	0
8/15/2014	10:22:00	4.84	3934	2.5	6.86	376	0	8/18/2014	10:06:00	5.51	4317	2.8	6.88	417	0
8/15/2014	10:23:00	4.8	3932	2.5	6.86	376	0	8/18/2014	10:07:00	5.49	4318	2.8	6.88	417	0
8/15/2014	10:24:00	4.79	3931	2.5	6.86	376	0	8/18/2014	10:08:00	5.5	4312	2.8	6.88	417	0
8/15/2014	10:25:00	4.81	3926	2.5	6.85	376	0	8/18/2014	10:09:00	5.52	4309	2.8	6.88	417	0
8/15/2014	10:26:00	4.83	3934	2.5	6.86	376	0	8/18/2014	10:10:00	5.48	4305	2.8	6.88	417	0
8/15/2014	10:27:00	4.81	3932	2.5	6.86	376	0	8/18/2014	10:11:00	5.48	4298	2.8	6.88	416	0
8/15/2014	10:28:00	4.81	3930	2.5	6.86	376	0	8/18/2014	10:12:00	5.48	4310	2.8	6.88	416	0
8/15/2014	10:29:00	4.84	3931	2.5	6.86	376	0	8/18/2014	10:13:00	5.52	4312	2.8	6.88	416	0
8/15/2014	10:30:00	4.83	3932	2.5	6.87	376	0	8/18/2014	10:14:00	5.49	4303	2.8	6.88	416	0
8/15/2014	10:31:00	4.83	3932	2.5	6.86	376	0	8/18/2014	10:15:00	5.47	4307	2.8	6.88	416	0
8/15/2014	10:32:00	4.82	3931	2.5	6.86	376	0	8/18/2014	10:16:00	5.43	4303	2.8	6.88	416	0
8/15/2014	10:33:00	4.84	3934	2.5	6.86	376	0	8/18/2014	10:17:00	5.49	4294	2.7	6.88	416	0
8/15/2014	10:34:00	4.81	3926	2.5	6.86	376	0	8/18/2014	10:18:00	5.5	4291	2.7	6.88	416	0
8/15/2014	10:35:00	4.82	3929	2.5	6.86	376	0	8/18/2014	10:19:00	5.5	4288	2.7	6.88	416	0
8/15/2014	10:36:00	4.81	3930	2.5	6.86	376	0	8/18/2014	10:20:00	5.47	4287	2.7	6.88	416	0
8/15/2014	10:37:00	4.81	3930	2.5	6.86	376	0	8/18/2014	10:21:00	5.54	4283	2.7	6.88	416	0
8/15/2014	10:38:00	4.8	3928	2.5	6.86	376	0	8/18/2014	10:22:00	5.5	4282	2.7	6.88	416	0
8/15/2014	10:39:00	4.79	3922	2.5	6.86	377	0	8/18/2014	10:23:00	5.5	4276	2.7	6.88	415	0
8/15/2014	10:40:00	4.84	3937	2.5	6.86	377	0	8/18/2014	10:24:00	5.54	4277	2.7	6.88	415	0
8/15/2014	10:41:00	4.79	3930	2.5	6.86	377	0	8/18/2014	10:25:00	5.54	4278	2.7	6.88	415	0
8/15/2014	10:42:00	4.82	3929	2.5	6.86	377	0	8/18/2014	10:26:00	5.56	4275	2.7	6.88	415	0

8/15/2014	10:43:00	4.79	3924	2.5	6.86	377	0	8/18/2014	10:27:00	5.56	4277	2.7	6.88	415	0
8/15/2014	10:44:00	4.82	3930	2.5	6.86	377	0	8/18/2014	10:28:00	5.52	4273	2.7	6.88	415	0
8/15/2014	10:45:00	4.79	3924	2.5	6.86	377	0	8/18/2014	10:29:00	5.56	4268	2.7	6.88	414	0
8/15/2014	10:46:00	4.8	3927	2.5	6.86	377	0	8/18/2014	10:30:00	5.66	4259	2.7	6.88	414	0
8/15/2014	10:47:00	4.83	3920	2.5	6.86	377	0	8/18/2014	10:31:00	5.51	4281	2.7	6.88	414	0
8/15/2014	10:48:00	4.84	3928	2.5	6.86	377	0	8/18/2014	10:32:00	5.44	4269	2.7	6.88	414	0
8/15/2014	10:49:00	4.82	3932	2.5	6.86	377	0	8/18/2014	10:33:00	5.54	4254	2.7	6.88	414	0
8/15/2014	10:50:00	4.82	3929	2.5	6.87	377	0	8/18/2014	10:34:00	5.54	4259	2.7	6.87	414	0
8/15/2014	10:51:00	4.86	3922	2.5	6.86	377	0	8/18/2014	10:35:00	5.54	4250	2.7	6.88	414	0
8/15/2014	10:52:00	4.87	3930	2.5	6.86	377	0	8/18/2014	10:36:00	5.54	4252	2.7	6.87	414	0
8/15/2014	10:53:00	4.84	3928	2.5	6.86	377	0	8/18/2014	10:37:00	5.55	4251	2.7	6.88	414	0
8/15/2014	10:54:00	4.86	3927	2.5	6.87	379	0	8/18/2014	10:38:00	5.55	4238	2.7	6.88	414	0
8/15/2014	10:55:00	4.8	3929	2.5	6.87	378	0	8/18/2014	10:39:00	5.54	4244	2.7	6.87	413	0
8/15/2014	10:56:00	4.91	3926	2.5	6.87	378	0	8/18/2014	10:40:00	5.53	4246	2.7	6.87	413	0
8/15/2014	10:57:00	4.9	3926	2.5	6.87	378	0	8/18/2014	10:41:00	5.53	4244	2.7	6.88	413	0
8/15/2014	10:58:00	4.91	3931	2.5	6.87	378	0	8/18/2014	10:42:00	5.57	4243	2.7	6.88	413	0
8/15/2014	10:59:00	4.8	3924	2.5	6.87	378	0	8/18/2014	10:43:00	5.56	4240	2.7	6.88	413	0
8/15/2014	11:00:00	4.86	3927	2.5	6.87	378	0	8/18/2014	10:44:00	5.56	4236	2.7	6.88	413	0
8/15/2014	11:01:00	4.9	3917	2.5	6.87	378	0	8/18/2014	10:45:00	5.51	4235	2.7	6.87	413	0
8/15/2014	11:02:00	4.82	3918	2.5	6.87	378	0	8/18/2014	10:46:00	5.42	4238	2.7	6.88	413	0
8/15/2014	11:03:00	4.87	3918	2.5	6.87	379	0	8/18/2014	10:47:00	5.47	4230	2.7	6.88	413	0
8/15/2014	11:04:00	4.87	3923	2.5	6.87	379	0	8/18/2014	10:48:00	5.6	4221	2.7	6.88	412	0
8/15/2014	11:05:00	5.85	105	0.1	6.93	383	0.77	8/18/2014	10:49:00	5.54	4221	2.7	6.88	412	0
8/15/2014	11:06:00	7.77	0	0	7.12	380	7.46	8/18/2014	10:50:00	5.55	4220	2.7	6.88	412	0

8/15/2014	11:07:00	7.42	0	0	7.25	375	9.04	8/18/2014	10:51:00	5.56	4220	2.7	6.88	412	0
8/15/2014	11:08:00	7.61	0	0	7.33	375	9.6	8/18/2014	10:52:00	5.61	4217	2.7	6.88	412	0
8/15/2014	11:09:00	7.93	0	0	7.37	375	9.89	8/18/2014	10:53:00	5.59	4209	2.7	6.88	412	0
8/15/2014	11:10:00	8.29	0	0	7.36	376	10.01	8/18/2014	10:54:00	5.6	4216	2.7	6.88	412	0
8/15/2014	11:11:00	8.64	0	0	7.33	380	10.05	8/18/2014	10:55:00	5.64	4219	2.7	6.89	412	0
8/15/2014	11:12:00	8.99	0	0	7.32	378	10.07	8/18/2014	10:56:00	5.6	4217	2.7	6.88	412	0
8/15/2014	11:13:00	9.32	0	0	7.26	380	10.06	8/18/2014	10:57:00	5.66	4218	2.7	6.88	412	0
8/15/2014	11:14:00	9.64	0	0	7.18	379	10.02	8/18/2014	10:58:00	5.59	4207	2.7	6.88	412	0
8/15/2014	11:15:00	9.95	0	0	7.11	382	9.97	8/18/2014	10:59:00	5.53	4208	2.7	6.88	412	0
8/15/2014	11:16:00	10.25	0	0	7.04	381	9.91	8/18/2014	11:00:00	5.74	4189	2.7	6.88	412	0
8/15/2014	11:17:00	10.53	0	0	7	380	9.85	8/18/2014	11:01:00	5.49	4214	2.7	6.88	412	0
8/15/2014	11:18:00	10.81	0	0	6.94	380	9.76	8/18/2014	11:02:00	5.38	4201	2.7	6.88	412	0
8/15/2014	11:19:00	11.07	0	0	6.87	380	9.76	8/18/2014	11:03:00	5.64	4192	2.7	6.89	412	0
8/15/2014	11:20:00	11.31	0	0	6.86	378	9.69	8/18/2014	11:04:00	5.63	4190	2.7	6.88	412	0
8/15/2014	11:21:00	11.55	0	0	6.86	380	9.62	8/18/2014	11:05:00	5.6	4188	2.7	6.88	412	0
8/15/2014	11:22:00	11.77	0	0	6.82	381	9.57	8/18/2014	11:06:00	5.54	4186	2.7	6.88	412	0
8/15/2014	11:23:00	11.99	0	0	6.8	384	9.53	8/18/2014	11:07:00	5.6	4196	2.7	6.88	412	0
8/15/2014	11:24:00	12.2	0	0	6.8	384	9.45	8/18/2014	11:08:00	5.59	4191	2.7	6.89	412	0
8/15/2014	11:25:00	12.4	0	0	6.78	385	9.4	8/18/2014	11:09:00	5.63	4183	2.7	6.89	411	0
8/15/2014	11:26:00	12.59	0	0	6.78	388	9.33	8/18/2014	11:10:00	5.56	4187	2.7	6.89	411	0
8/15/2014	11:27:00	12.76	0	0	6.77	387	9.2	8/18/2014	11:11:00	5.62	4186	2.7	6.89	411	0
8/15/2014	11:28:00	12.92	0	0	6.76	387	9.17	8/18/2014	11:12:00	5.5	4184	2.7	6.89	411	0
8/15/2014	11:29:00	13.08	0	0	6.76	389	9.13	8/18/2014	11:13:00	5.59	4179	2.7	6.89	411	0
8/15/2014	11:30:00	13.23	0	0	6.76	390	9.1	8/18/2014	11:14:00	5.55	4174	2.7	6.88	411	0

8/15/2014	11:31:00	13.37	0	0	6.75	390	9.04	8/18/2014	11:15:00	5.54	4180	2.7	6.88	411	0
8/15/2014	11:32:00	13.51	0	0	6.75	392	9.03	8/18/2014	11:16:00	5.49	4179	2.7	6.88	411	0
8/15/2014	11:33:00	13.64	0	0	6.75	393	9.03	8/18/2014	11:17:00	5.54	4173	2.7	6.87	411	0
8/15/2014	11:34:00	13.76	0	0	6.75	394	8.97	8/18/2014	11:18:00	5.63	4173	2.7	6.88	411	0
8/15/2014	11:35:00	13.87	0	0	6.69	395	8.86	8/18/2014	11:19:00	5.55	4170	2.7	6.88	411	0
8/15/2014	11:36:00	14	0	0	6.73	395	8.93	8/18/2014	11:20:00	5.56	4167	2.7	6.88	411	0
8/15/2014	11:37:00	14.08	0	0	6.74	395	8.92	8/18/2014	11:21:00	5.44	4166	2.7	6.89	411	0
8/15/2014	11:38:00	8.67	5974	3.8	7.39	408	0.86	8/18/2014	11:22:00	5.58	4164	2.7	6.88	411	0
8/15/2014	11:39:00	8.13	5976	3.8	7.4	404	0.55	8/18/2014	11:23:00	5.53	4157	2.7	6.88	411	0
8/15/2014	11:40:00	7.79	5977	3.8	7.4	403	0.54	8/18/2014	11:24:00	5.57	4152	2.7	6.89	411	0
8/15/2014	11:41:00	7.78	5985	3.8	7.41	401	0.54	8/18/2014	11:25:00	5.56	4162	2.7	6.89	411	0
8/15/2014	11:42:00	7.78	5979	3.8	7.39	401	0.55	8/18/2014	11:26:00	5.53	4151	2.7	6.89	411	0
8/15/2014	11:43:00	7.79	5963	3.8	7.38	400	0.54	8/18/2014	11:27:00	5.55	4153	2.7	6.89	411	0
8/15/2014	11:44:00	7.87	5980	3.8	7.39	400	0.55	8/18/2014	11:28:00	5.64	4138	2.6	6.95	411	0
8/15/2014	11:45:00	8.02	5981	3.8	7.4	400	0.55	8/18/2014	11:29:00	5.6	4153	2.7	6.9	411	0
8/15/2014	11:46:00	8.07	5978	3.8	7.4	400	0.55	8/18/2014	11:30:00	5.63	4153	2.7	6.9	411	0
8/15/2014	11:47:00	7.99	5978	3.8	7.4	400	0.56	8/18/2014	11:31:00	5.55	4152	2.7	6.9	411	0
8/15/2014	11:48:00	8	5987	3.8	7.4	400	0.55	8/18/2014	11:32:00	5.64	4149	2.7	6.9	411	0
8/15/2014	11:49:00	8.06	5979	3.8	7.4	400	0.55	8/18/2014	11:33:00	5.58	4144	2.7	6.88	411	0
8/15/2014	11:50:00	8.16	5969	3.8	7.4	400	0.56	8/18/2014	11:34:00	5.6	4144	2.7	6.9	411	0
8/15/2014	11:51:00	8.17	5988	3.8	7.4	401	0.56	8/18/2014	11:35:00	5.58	4143	2.7	6.9	411	0
8/15/2014	11:52:00	8.24	5980	3.8	7.4	401	0.56	8/18/2014	11:36:00	5.5	4143	2.7	6.9	411	0
8/15/2014	11:53:00	8.31	5988	3.8	7.4	402	0.56	8/18/2014	11:37:00	5.59	4135	2.6	6.9	411	0
8/15/2014	11:54:00	8.21	5987	3.8	7.41	402	0.57	8/18/2014	11:38:00	5.54	4135	2.6	6.9	411	0

8/15/2014	11:55:00	8.28	5988	3.8	7.4	402	0.57	8/18/2014	11:39:00	5.65	4136	2.6	6.9	411	0
8/15/2014	11:56:00	8.37	5987	3.8	7.4	403	0.58	8/18/2014	11:40:00	5.63	4130	2.6	6.9	411	0
8/15/2014	11:57:00	8.4	5978	3.8	7.41	403	0.58	8/18/2014	11:41:00	5.66	4129	2.6	6.9	411	0
8/15/2014	11:58:00	8.31	5986	3.8	7.41	404	0.58	8/18/2014	11:42:00	5.68	4131	2.6	6.9	411	0
8/15/2014	11:59:00	8.3	5974	3.8	7.41	405	0.58	8/18/2014	11:43:00	5.58	4117	2.6	6.9	411	0
8/15/2014	12:00:00	8.39	5980	3.8	7.41	405	0.59	8/18/2014	11:44:00	5.7	4131	2.6	6.92	411	0
8/15/2014	12:01:00	8.39	5980	3.8	7.41	406	0.59	8/18/2014	11:45:00	5.58	4120	2.6	6.89	411	0
8/15/2014	12:02:00	8.53	5988	3.8	7.41	406	0.59	8/18/2014	11:46:00	5.55	4133	2.6	6.9	411	0
8/15/2014	12:03:00	8.51	5981	3.8	7.42	407	0.67	8/18/2014	11:47:00	5.54	4123	2.6	6.89	411	0
8/15/2014	12:04:00	8.5	5988	3.8	7.41	408	0.74	8/18/2014	11:48:00	5.68	4118	2.6	6.87	411	0
8/15/2014	12:05:00	8.5	5975	3.8	7.43	408	0.81	8/18/2014	11:49:00	5.61	4121	2.6	6.9	410	0
8/15/2014	12:06:00	8.39	5985	3.8	7.44	409	0.85	8/18/2014	11:50:00	5.65	4119	2.6	6.9	410	0
8/15/2014	12:07:00	8.5	5988	3.8	7.44	409	0.88	8/18/2014	11:51:00	5.69	4118	2.6	6.9	411	0
8/15/2014	12:08:00	8.61	5987	3.8	7.45	410	0.9	8/18/2014	11:52:00	5.61	4118	2.6	6.9	411	0
8/15/2014	12:09:00	8.53	5976	3.8	7.45	410	0.94	8/18/2014	11:53:00	5.63	4115	2.6	6.9	410	0
8/15/2014	12:10:00	8.58	5979	3.8	7.46	410	0.97	8/18/2014	11:54:00	5.73	4111	2.6	6.9	410	0
8/15/2014	12:11:00	8.61	5975	3.8	7.47	411	0.99	8/18/2014	11:55:00	5.65	4110	2.6	6.91	410	0
8/15/2014	12:12:00	8.56	5978	3.8	7.47	411	1.02	8/18/2014	11:56:00	5.77	4108	2.6	6.9	410	0
8/15/2014	12:13:00	8.65	5987	3.8	7.48	412	1.05	8/18/2014	11:57:00	5.62	4111	2.6	6.91	410	0
8/15/2014	12:14:00	8.8	5986	3.8	7.47	412	1.05	8/18/2014	11:58:00	5.65	4111	2.6	6.9	411	0
8/15/2014	12:15:00	8.81	5984	3.8	7.48	413	1.08	8/18/2014	11:59:00	5.67	4104	2.6	6.91	411	0
8/15/2014	12:16:00	8.92	5976	3.8	7.5	413	1.13	8/18/2014	12:00:00	5.58	4089	2.6	6.9	411	0
8/15/2014	12:17:00	8.96	5976	3.8	7.5	414	1.19	8/18/2014	12:01:00	5.4	4110	2.6	6.91	411	0
8/15/2014	12:18:00	8.98	5973	3.8	7.51	414	1.25	8/18/2014	12:02:00	5.54	4104	2.6	6.89	411	0

8/15/2014	12:19:00	8.93	5970	3.8	7.52	415	1.3	8/18/2014	12:03:00	5.69	4097	2.6	6.91	410	0
8/15/2014	12:20:00	8.86	5976	3.8	7.53	415	1.35	8/18/2014	12:04:00	5.6	4105	2.6	6.89	411	0
8/15/2014	12:21:00	8.95	5976	3.8	7.53	416	1.39	8/18/2014	12:05:00	5.64	4105	2.6	6.91	411	0
8/15/2014	12:22:00	8.94	5975	3.8	7.54	416	1.42	8/18/2014	12:06:00	5.75	4098	2.6	6.91	411	0
8/15/2014	12:23:00	8.97	5986	3.8	7.55	417	1.46	8/18/2014	12:07:00	5.73	4093	2.6	6.91	411	0
8/15/2014	12:24:00	8.93	5986	3.8	7.56	417	1.48	8/18/2014	12:08:00	5.57	4093	2.6	6.91	411	0
8/15/2014	12:25:00	8.99	5986	3.8	7.56	418	1.5	8/18/2014	12:09:00	5.66	4092	2.6	6.91	411	0
8/15/2014	12:26:00	9.07	5962	3.8	7.57	418	1.52	8/18/2014	12:10:00	5.59	4100	2.6	6.91	411	0
8/15/2014	12:27:00	9.12	5975	3.8	7.58	418	1.54	8/18/2014	12:11:00	5.63	4097	2.6	6.91	411	0
8/15/2014	12:28:00	9.05	5975	3.8	7.58	419	1.57	8/18/2014	12:12:00	5.71	4092	2.6	6.91	411	0
8/15/2014	12:29:00	9.14	5977	3.8	7.6	419	1.57	8/18/2014	12:13:00	5.63	4087	2.6	6.91	411	0
8/15/2014	12:30:00	9.2	5985	3.8	7.61	420	1.59	8/18/2014	12:14:00	5.64	4088	2.6	6.91	411	0
8/15/2014	12:31:00	9.12	5974	3.8	7.62	421	1.62	8/18/2014	12:15:00	5.71	4093	2.6	6.93	411	0
8/15/2014	12:32:00	9.21	5985	3.8	7.62	421	1.63	8/18/2014	12:16:00	5.39	4097	2.6	6.92	411	0
8/15/2014	12:33:00	9.28	5975	3.8	7.63	421	1.62	8/18/2014	12:17:00	5.43	4086	2.6	6.92	411	0
8/15/2014	12:34:00	9.33	5975	3.8	7.65	422	1.64	8/18/2014	12:18:00	5.6	4086	2.6	6.91	411	0
8/15/2014	12:35:00	9.26	5975	3.8	7.65	422	1.65	8/18/2014	12:19:00	5.64	4084	2.6	6.92	411	0
8/15/2014	12:36:00	9.16	5974	3.8	7.66	422	1.68	8/18/2014	12:20:00	5.68	4085	2.6	6.91	411	0
8/15/2014	12:37:00	9.13	5975	3.8	7.67	422	1.71	8/18/2014	12:21:00	5.71	4076	2.6	6.9	411	0
8/15/2014	12:38:00	9.08	5972	3.8	7.67	423	1.72	8/18/2014	12:22:00	5.55	4077	2.6	6.91	411	0
8/15/2014	12:39:00	9.03	5983	3.8	7.68	423	1.73	8/18/2014	12:23:00	5.46	4083	2.6	6.9	410	0
8/15/2014	12:40:00	9.19	5975	3.8	7.69	423	1.72	8/18/2014	12:24:00	5.61	4077	2.6	6.9	411	0
8/15/2014	12:41:00	9.23	5983	3.8	7.7	424	1.71	8/18/2014	12:25:00	5.56	4084	2.6	6.9	411	0
8/15/2014	12:42:00	9.34	5974	3.8	7.71	424	1.7	8/18/2014	12:26:00	5.66	4081	2.6	6.9	410	0

8/15/2014	12:43:00	9.38	5981	3.8	7.7	424	1.68	8/18/2014	12:27:00	5.57	4078	2.6	6.88	411	0
8/15/2014	12:44:00	9.18	5970	3.8	7.72	425	1.65	8/18/2014	12:28:00	5.6	4071	2.6	6.89	411	0
8/15/2014	12:45:00	9.27	5983	3.8	7.73	425	1.63	8/18/2014	12:29:00	5.65	4077	2.6	6.89	411	0
8/15/2014	12:46:00	9.46	5973	3.8	7.74	425	1.59	8/18/2014	12:30:00	5.58	4073	2.6	6.9	411	0
8/15/2014	12:47:00	9.5	5972	3.8	7.74	426	1.57	8/18/2014	12:31:00	5.59	4074	2.6	6.9	411	0
8/15/2014	12:48:00	9.42	5971	3.8	7.75	427	1.62	8/18/2014	12:32:00	5.59	4067	2.6	6.9	411	0
8/15/2014	12:49:00	9.42	5982	3.8	7.75	427	1.63	8/18/2014	12:33:00	5.67	4072	2.6	6.9	411	0
8/15/2014	12:50:00	9.43	5971	3.8	7.75	428	1.62	8/18/2014	12:34:00	5.65	4065	2.6	6.9	411	0
8/15/2014	12:51:00	9.56	5982	3.8	7.75	428	1.63	8/18/2014	12:35:00	5.67	4069	2.6	6.9	411	0
8/15/2014	12:52:00	9.71	5980	3.8	7.75	429	1.63	8/18/2014	12:36:00	5.64	4066	2.6	6.9	411	0
8/15/2014	12:53:00	9.66	5980	3.8	7.75	429	1.64	8/18/2014	12:37:00	5.63	4066	2.6	6.9	411	0
8/15/2014	12:54:00	9.5	5969	3.8	7.76	430	1.64	8/18/2014	12:38:00	5.63	4060	2.6	6.9	411	0
8/15/2014	12:55:00	9.31	5980	3.8	7.75	430	1.64	8/18/2014	12:39:00	5.69	4062	2.6	6.9	411	0
8/15/2014	12:56:00	9.33	5973	3.8	7.76	431	1.63	8/18/2014	12:40:00	5.57	4058	2.6	6.9	411	0
8/15/2014	12:57:00	9.57	5984	3.8	7.75	431	1.65	8/18/2014	12:41:00	5.56	4065	2.6	6.91	411	0
8/15/2014	12:58:00	9.75	5972	3.8	7.75	432	1.65	8/18/2014	12:42:00	5.65	4059	2.6	6.91	411	0
8/15/2014	12:59:00	9.66	5973	3.8	7.76	433	1.64	8/18/2014	12:43:00	5.66	4062	2.6	6.91	411	0
8/15/2014	13:00:00	9.7	5973	3.8	7.75	433	1.65	8/18/2014	12:44:00	5.41	4052	2.6	6.87	411	0
8/15/2014	13:01:00	9.69	5981	3.8	7.75	434	1.64	8/18/2014	12:45:00	5.42	4063	2.6	6.89	411	0
8/15/2014	13:02:00	9.6	5972	3.8	7.76	435	1.64	8/18/2014	12:46:00	5.41	4059	2.6	6.9	411	0
8/15/2014	13:03:00	9.6	5974	3.8	7.76	435	1.65	8/18/2014	12:47:00	5.44	4063	2.6	6.9	411	0
8/15/2014	13:04:00	9.73	5972	3.8	7.76	436	1.65	8/18/2014	12:48:00	5.54	4053	2.6	6.9	411	0
8/15/2014	13:05:00	9.82	5982	3.8	7.75	436	1.65	8/18/2014	12:49:00	5.59	4058	2.6	6.89	411	0
8/15/2014	13:06:00	9.87	5973	3.8	7.76	437	1.65	8/18/2014	12:50:00	5.54	4050	2.6	6.89	411	0

8/15/2014	13:07:00	9.92	5983	3.8	7.76	438	1.65	8/18/2014	12:51:00	5.54	4036	2.6	6.89	411	0
8/15/2014	13:08:00	9.9	5982	3.8	7.76	438	1.65	8/18/2014	12:52:00	5.46	4050	2.6	6.89	411	0
8/15/2014	13:09:00	9.93	5982	3.8	7.76	439	1.65	8/18/2014	12:53:00	5.41	4052	2.6	6.9	411	0
8/15/2014	13:10:00	10.02	5982	3.8	7.77	440	1.65	8/18/2014	12:54:00	5.45	4054	2.6	6.9	411	0
8/15/2014	13:11:00	9.91	5972	3.8	7.76	440	1.65	8/18/2014	12:55:00	5.47	4048	2.6	6.9	411	0
8/15/2014	13:12:00	9.99	5981	3.8	7.76	441	1.65	8/18/2014	12:56:00	5.46	4053	2.6	6.9	410	0
8/15/2014	13:13:00	9.8	5982	3.8	7.76	441	1.66	8/18/2014	12:57:00	5.48	4047	2.6	6.9	410	0
8/15/2014	13:14:00	9.84	5973	3.8	7.77	442	1.65	8/18/2014	12:58:00	5.5	4048	2.6	6.9	410	0
8/15/2014	13:15:00	9.92	5981	3.8	7.77	442	1.65	8/18/2014	12:59:00	5.5	4046	2.6	6.9	410	0
8/15/2014	13:16:00	10.01	5974	3.8	7.76	443	1.66	8/18/2014	13:00:00	5.44	4047	2.6	6.9	410	0
8/15/2014	13:17:00	10.19	5974	3.8	7.76	443	1.65	8/18/2014	13:01:00	5.49	4043	2.6	6.9	410	0
8/15/2014	13:18:00	10.34	5985	3.8	7.76	444	1.66	8/18/2014	13:02:00	5.52	4042	2.6	6.9	410	0
8/15/2014	13:19:00	10.41	5975	3.8	7.76	445	1.68	8/18/2014	13:03:00	5.4	4032	2.6	6.9	410	0
8/15/2014	13:20:00	10.48	5977	3.8	7.76	445	1.68	8/18/2014	13:04:00	5.52	4044	2.6	6.9	410	0
8/15/2014	13:21:00	10.59	5812	3.7	7.76	446	1.7	8/18/2014	13:05:00	5.59	4046	2.6	6.9	410	0
8/15/2014	13:22:00	11.11	5981	3.8	7.76	446	1.83	8/18/2014	13:06:00	5.61	4041	2.6	6.9	410	0
8/15/2014	13:23:00	10.6	5977	3.8	7.78	450	1.7	8/18/2014	13:07:00	5.7	4038	2.6	6.9	410	0
8/15/2014	13:24:00	10.65	5963	3.8	7.77	450	1.67	8/18/2014	13:08:00	5.54	4028	2.6	6.9	410	0
8/15/2014	13:25:00	11.13	4209	2.7	7.8	454	4.09	8/18/2014	13:09:00	5.6	4040	2.6	6.9	410	0
8/15/2014	13:26:00	11.55	0	0	7.95	450	8.78	8/18/2014	13:10:00	5.55	4038	2.6	6.9	410	0
8/15/2014	13:27:00	12.07	0	0	8.05	447	8.83	8/18/2014	13:11:00	5.57	4043	2.6	6.9	409	0
8/15/2014	13:28:00	12.59	0	0	8.08	447	8.82	8/18/2014	13:12:00	5.4	4039	2.6	6.9	409	0
8/15/2014	13:29:00	13.06	0	0	8.08	447	8.81	8/18/2014	13:13:00	5.41	4035	2.6	6.9	409	0
8/15/2014	13:30:00	13.51	0	0	8.06	447	8.78	8/18/2014	13:14:00	5.49	4036	2.6	6.9	409	0

8/15/2014	13:31:00	13.94	0	0	8.03	449	8.74	8/18/2014	13:15:00	5.66	4015	2.6	6.88	409	0
								8/18/2014	13:16:00	5.36	4042	2.6	6.9	409	0
								8/18/2014	13:17:00	5.42	4033	2.6	6.91	409	0
								8/18/2014	13:18:00	5.41	4037	2.6	6.89	409	0
								8/18/2014	13:19:00	5.45	4041	2.6	6.9	409	0
								8/18/2014	13:20:00	5.41	4040	2.6	6.9	409	0
								8/18/2014	13:21:00	5.51	4033	2.6	6.91	409	0
								8/18/2014	13:22:00	5.46	4032	2.6	6.91	409	0
								8/18/2014	13:23:00	5.53	4031	2.6	6.9	409	0
								8/18/2014	13:24:00	5.56	4027	2.6	6.89	409	0
								8/18/2014	13:25:00	5.57	4028	2.6	6.9	409	0
								8/18/2014	13:26:00	5.64	4032	2.6	6.89	409	0
								8/18/2014	13:27:00	5.6	4031	2.6	6.9	409	0
								8/18/2014	13:28:00	5.61	4032	2.6	6.9	409	0
								8/18/2014	13:29:00	5.71	4025	2.6	6.9	409	0
								8/18/2014	13:30:00	5.7	4025	2.6	6.9	409	0
								8/18/2014	13:31:00	5.76	4026	2.6	6.91	409	0
								8/18/2014	13:32:00	5.73	4023	2.6	6.91	409	0
								8/18/2014	13:33:00	5.72	4022	2.6	6.9	409	0
								8/18/2014	13:34:00	5.73	4024	2.6	6.87	409	0
								8/18/2014	13:35:00	5.75	4026	2.6	6.9	409	0
								8/18/2014	13:36:00	5.65	4027	2.6	6.9	409	0
								8/18/2014	13:37:00	5.76	4027	2.6	6.9	409	0
								8/18/2014	13:38:00	5.87	4026	2.6	6.9	409	0
								8/18/2014	13:39:00	5.79	4025	2.6	6.9	410	0
								8/18/2014	13:40:00	5.71	4025	2.6	6.91	410	0
								8/18/2014	13:41:00	5.65	4023	2.6	6.91	410	0
								8/18/2014	13:42:00	5.76	4018	2.6	6.91	410	0
								8/18/2014	13:43:00	5.61	4023	2.6	6.91	410	0

								8/18/2014	13:44:00	5.72	4018	2.6	6.91	410	0
								8/18/2014	13:45:00	5.64	4011	2.6	6.95	410	0
								8/18/2014	13:46:00	5.61	4029	2.6	6.93	410	0
								8/18/2014	13:47:00	5.7	4023	2.6	6.94	410	0
								8/18/2014	13:48:00	5.81	4023	2.6	6.96	410	0
								8/18/2014	13:49:00	5.74	4020	2.6	6.94	410	0
								8/18/2014	13:50:00	5.67	4018	2.6	6.94	410	0
								8/18/2014	13:51:00	5.73	4015	2.6	6.93	410	0
								8/18/2014	13:52:00	5.79	4015	2.6	6.93	410	0
								8/18/2014	13:53:00	5.78	4014	2.6	6.93	410	0
								8/18/2014	13:54:00	5.69	4017	2.6	6.93	410	0
								8/18/2014	13:55:00	5.65	4015	2.6	6.93	410	0
								8/18/2014	13:56:00	5.69	4012	2.6	6.92	410	0
								8/18/2014	13:57:00	5.83	4016	2.6	6.92	410	0
								8/18/2014	13:58:00	5.73	4014	2.6	6.92	410	0
								8/18/2014	13:59:00	5.71	4012	2.6	6.92	411	0
								8/18/2014	14:00:00	5.68	4017	2.6	6.92	411	0
								8/18/2014	14:01:00	5.72	4017	2.6	6.93	411	0
								8/18/2014	14:02:00	5.84	4009	2.6	6.9	411	0
								8/18/2014	14:03:00	5.67	4006	2.6	6.91	411	0
								8/18/2014	14:04:00	5.64	4006	2.6	6.92	411	0
								8/18/2014	14:05:00	5.67	4010	2.6	6.92	411	0
								8/18/2014	14:06:00	5.8	4010	2.6	6.92	411	0
								8/18/2014	14:07:00	5.55	4010	2.6	6.92	411	0
								8/18/2014	14:08:00	5.74	4005	2.6	6.92	411	0
								8/18/2014	14:09:00	5.87	4000	2.6	6.92	411	0
								8/18/2014	14:10:00	5.7	4004	2.6	6.93	411	0
								8/18/2014	14:11:00	5.65	4007	2.6	6.93	411	0
								8/18/2014	14:12:00	5.66	4004	2.6	6.93	411	0
								8/18/2014	14:13:00	5.8	4002	2.6	6.93	411	0

								8/18/2014	14:14:00	5.88	4004	2.6	6.94	411	0
								8/18/2014	14:15:00	6.09	3989	2.6	6.94	411	0
								8/18/2014	14:16:00	6.06	4010	2.6	6.94	412	0
								8/18/2014	14:17:00	5.44	4009	2.6	6.96	412	0
								8/18/2014	14:18:00	5.6	4000	2.6	6.95	412	0
								8/18/2014	14:19:00	5.73	3996	2.6	6.93	412	0
								8/18/2014	14:20:00	5.84	4005	2.6	6.94	412	0
								8/18/2014	14:21:00	5.77	4005	2.6	6.92	412	0
								8/18/2014	14:22:00	5.7	3991	2.6	6.94	412	0
								8/18/2014	14:23:00	5.57	4004	2.6	6.93	412	0
								8/18/2014	14:24:00	5.71	4003	2.6	6.93	412	0
								8/18/2014	14:25:00	5.74	4003	2.6	6.93	412	0
								8/18/2014	14:26:00	5.77	3999	2.6	6.93	412	0
								8/18/2014	14:27:00	5.94	3998	2.6	6.94	412	0
								8/18/2014	14:28:00	5.92	4004	2.6	6.92	412	0
								8/18/2014	14:29:00	5.8	3994	2.6	6.94	413	0
								8/18/2014	14:30:00	5.68	3994	2.6	6.94	413	0
								8/18/2014	14:31:00	5.71	3996	2.6	6.93	413	0
								8/18/2014	14:32:00	5.62	3997	2.6	6.93	413	0
								8/18/2014	14:33:00	5.64	3998	2.6	6.93	413	0
								8/18/2014	14:34:00	5.81	3989	2.6	6.93	413	0
								8/18/2014	14:35:00	5.75	4004	2.6	6.93	413	0
								8/18/2014	14:36:00	5.83	3997	2.6	6.93	413	0
								8/18/2014	14:37:00	5.74	3996	2.6	6.93	413	0
								8/18/2014	14:38:00	5.89	3991	2.6	6.93	413	0
								8/18/2014	14:39:00	5.75	3996	2.6	6.94	413	0
								8/18/2014	14:40:00	5.76	3994	2.6	6.93	413	0
								8/18/2014	14:41:00	5.76	3997	2.6	6.93	413	0
								8/18/2014	14:42:00	5.64	3992	2.6	6.93	413	0
								8/18/2014	14:43:00	5.78	3995	2.6	6.93	413	0

								8/18/2014	14:44:00	5.84	3991	2.6	6.85	413	0
								8/18/2014	14:45:00	5.8	3994	2.6	6.95	413	0
								8/18/2014	14:46:00	5.68	3998	2.6	6.96	413	0
								8/18/2014	14:47:00	5.72	3987	2.6	6.93	413	0
								8/18/2014	14:48:00	5.74	3981	2.5	6.94	413	0
								8/18/2014	14:49:00	5.86	3997	2.6	7.01	413	0
								8/18/2014	14:50:00	5.83	3997	2.6	6.93	413	0
								8/18/2014	14:51:00	5.8	3992	2.6	6.94	413	0
								8/18/2014	14:52:00	5.86	3991	2.6	6.92	413	0
								8/18/2014	14:53:00	5.82	3993	2.6	6.93	413	0
								8/18/2014	14:54:00	5.88	3988	2.6	6.93	413	0
								8/18/2014	14:55:00	5.86	3992	2.6	6.94	413	0
								8/18/2014	14:56:00	5.66	3992	2.6	6.91	413	0
								8/18/2014	14:57:00	5.67	3984	2.5	6.93	413	0
								8/18/2014	14:58:00	5.73	3993	2.6	6.93	413	0
								8/18/2014	14:59:00	5.81	3990	2.6	6.93	413	0
								8/18/2014	15:00:00	5.85	3989	2.6	6.95	413	0
								8/18/2014	15:01:00	5.92	3990	2.6	6.91	413	0
								8/18/2014	15:02:00	5.82	3986	2.6	6.93	413	0
								8/18/2014	15:03:00	5.8	3988	2.6	6.92	413	0
								8/18/2014	15:04:00	5.8	3984	2.5	6.94	413	0
								8/18/2014	15:05:00	5.89	3985	2.6	6.95	413	0
								8/18/2014	15:06:00	5.8	3984	2.5	6.94	413	0
								8/18/2014	15:07:00	5.69	3986	2.6	6.94	413	0
								8/18/2014	15:08:00	5.78	3991	2.6	6.95	413	0
								8/18/2014	15:09:00	5.58	3991	2.6	6.94	414	0
								8/18/2014	15:10:00	5.87	3993	2.6	6.96	413	0
								8/18/2014	15:11:00	5.92	3991	2.6	6.95	413	0
								8/18/2014	15:12:00	5.69	3981	2.5	6.94	414	0
								8/18/2014	15:13:00	5.74	3980	2.5	6.95	413	0

								8/18/2014	15:14:00	5.68	3980	2.5	6.93	413	0
								8/18/2014	15:15:00	5.89	3971	2.5	6.94	413	0
								8/18/2014	15:16:00	5.62	3991	2.6	6.86	414	0
								8/18/2014	15:17:00	5.63	3980	2.5	6.9	414	0
								8/18/2014	15:18:00	5.7	3980	2.5	6.96	414	0
								8/18/2014	15:19:00	5.66	3987	2.6	6.93	414	0
								8/18/2014	15:20:00	5.79	3988	2.6	6.88	414	0
								8/18/2014	15:21:00	5.65	3978	2.5	6.93	414	0
								8/18/2014	15:22:00	5.68	3976	2.5	6.93	414	0
								8/18/2014	15:22:00	5.68	3976	2.5	6.93	414	0
								8/18/2014	15:23:00	5.87	3980	2.5	6.93	414	0
								8/18/2014	15:24:00	5.87	3980	2.5	6.94	414	0
								8/18/2014	15:25:00	5.65	3977	2.5	6.94	414	0
								8/18/2014	15:26:00	5.75	3977	2.5	6.94	414	0
								8/18/2014	15:27:00	5.71	3978	2.5	6.94	414	0
								8/18/2014	15:28:00	5.87	3968	2.5	6.94	414	0
								8/18/2014	15:29:00	5.72	3977	2.5	6.95	414	0
								8/18/2014	15:30:00	5.78	3965	2.5	6.93	414	0
								8/18/2014	15:31:00	5.75	3980	2.5	6.95	414	0
								8/18/2014	15:32:00	5.81	3979	2.5	6.94	414	0
								8/18/2014	15:33:00	5.76	3974	2.5	6.95	414	0
								8/18/2014	15:34:00	5.76	3984	2.5	6.94	414	0
								8/18/2014	15:35:00	5.8	3976	2.5	6.94	414	0
								8/18/2014	15:36:00	5.71	3980	2.5	6.95	414	0
								8/18/2014	15:37:00	5.71	3975	2.5	6.93	414	0
								8/18/2014	15:38:00	5.69	3979	2.5	6.93	414	0
								8/18/2014	15:39:00	5.69	3979	2.5	6.94	414	0
								8/18/2014	15:40:00	5.77	3975	2.5	6.93	414	0
								8/18/2014	15:41:00	5.85	3975	2.5	6.94	414	0
								8/18/2014	15:42:00	5.88	3973	2.5	6.94	414	0

								8/18/2014	15:43:00	5.72	3971	2.5	6.94	414	0
								8/18/2014	15:44:00	5.73	3978	2.5	6.95	414	0
								8/18/2014	15:45:00	5.71	3973	2.5	6.96	413	0
								8/18/2014	15:46:00	5.58	3976	2.5	7.01	413	0
								8/18/2014	15:47:00	5.64	3970	2.5	6.96	413	0
								8/18/2014	15:48:00	5.69	3973	2.5	6.96	413	0
								8/18/2014	15:49:00	5.73	3974	2.5	6.97	413	0
								8/18/2014	15:51:00	5.74	3975	2.5	7.01	413	0
								8/18/2014	15:52:00	5.71	3971	2.5	6.99	413	0
								8/18/2014	15:52:00	5.71	3971	2.5	6.99	413	0
								8/18/2014	15:53:00	5.76	3969	2.5	6.98	413	0
								8/18/2014	15:54:00	5.64	3974	2.5	6.99	413	0
								8/18/2014	15:55:00	5.55	3969	2.5	6.94	413	0
								8/18/2014	15:56:00	5.67	3971	2.5	6.95	413	0
								8/18/2014	15:57:00	5.82	3970	2.5	6.96	412	0
								8/18/2014	15:58:00	5.75	3975	2.5	6.95	412	0
								8/18/2014	15:59:00	5.59	3975	2.5	6.96	412	0
								8/18/2014	16:00:00	5.7	3968	2.5	6.95	412	0
								8/18/2014	16:01:00	5.76	3974	2.5	6.96	412	0
								8/18/2014	16:02:00	5.7	3971	2.5	6.95	412	0
								8/18/2014	16:03:00	5.75	3972	2.5	6.96	412	0
								8/18/2014	16:04:00	5.83	3975	2.5	6.95	412	0
								8/18/2014	16:05:00	5.8	3975	2.5	6.95	412	0
								8/18/2014	16:06:00	5.64	3974	2.5	6.96	412	0
								8/18/2014	16:07:00	5.67	3973	2.5	6.96	411	0
								8/18/2014	16:08:00	5.87	3968	2.5	6.96	411	0
								8/18/2014	16:09:00	5.8	3971	2.5	6.95	411	0
								8/18/2014	16:10:00	5.71	3969	2.5	6.95	411	0
								8/18/2014	16:11:00	5.68	3971	2.5	6.95	411	0
								8/18/2014	16:12:00	5.66	3972	2.5	6.95	411	0

								8/18/2014	16:13:00	5.7	3972	2.5	6.95	411	0
								8/18/2014	16:14:00	5.88	3967	2.5	6.82	411	0
								8/18/2014	16:15:00	6.02	3968	2.5	6.94	411	0
								8/18/2014	16:16:00	5.5	3967	2.5	6.95	411	0
								8/18/2014	16:17:00	6.94	3903	2.5	7	411	0
								8/18/2014	16:18:00	8.87	0	0	7.34	406	9.1
								8/18/2014	16:19:00	9.87	0	0	7.48	406	9.78

Table C11. Hydrolab data for push-pull test 3 conducted at well 1D in 2014.

INJECTION								EXTRACTION							
Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)	Date	Time	Temp (°C)	SpCond (µS/cm)	TDS (g/L)	pH	ORP (mV)	LDO (mg/L)
8/22/2014	8:18:00	4.94	3757	2.4	6.81	430	0	8/25/2014	7:43:00	11.06	0	0	7.35	439	9.15
8/22/2014	8:19:00	4.94	3763	2.4	6.81	430	0	8/25/2014	7:44:00	10.83	0	0	7.41	438	9.21
8/22/2014	8:20:00	4.94	3757	2.4	6.81	429	0	8/25/2014	7:45:00	10.61	0	0	7.44	437	9.22
8/22/2014	8:21:00	4.94	3747	2.4	6.81	428	0	8/25/2014	7:46:00	10.42	0	0	7.48	431	9.29
8/22/2014	8:22:00	4.94	3745	2.4	6.81	428	0	8/25/2014	7:47:00	10.24	0	0	7.5	438	9.34
8/22/2014	8:23:00	4.94	3734	2.4	6.81	427	0	8/25/2014	7:48:00	10.06	0	0	7.53	438	9.4
8/22/2014	8:24:00	4.93	3727	2.4	6.82	427	0	8/25/2014	7:49:00	9.89	0	0	7.54	438	9.49
8/22/2014	8:25:00	4.93	3725	2.4	6.82	426	0	8/25/2014	7:50:00	9.74	0	0	7.55	438	9.54
8/22/2014	8:26:00	4.93	3712	2.4	6.82	425	0	8/25/2014	7:51:00	9.58	0	0	7.57	437	9.59
8/22/2014	8:27:00	4.92	3710	2.4	6.82	425	0	8/25/2014	7:52:00	9.45	0	0	7.59	437	9.66
8/22/2014	8:28:00	4.91	3709	2.4	6.82	424	0	8/25/2014	7:53:00	9.31	0	0	7.6	436	9.75
8/22/2014	8:29:00	4.91	3698	2.4	6.82	423	0	8/25/2014	7:54:00	9.18	0	0	7.61	436	9.78
8/22/2014	8:30:00	4.91	3696	2.4	6.82	422	0	8/25/2014	7:55:00	9.07	0	0	7.62	436	9.82
8/22/2014	8:31:00	4.85	3695	2.4	6.82	421	0	8/25/2014	7:56:00	8.95	0	0	7.63	430	9.87
8/22/2014	8:32:00	4.88	3693	2.4	6.83	421	0	8/25/2014	7:57:00	8.85	0	0	7.64	436	9.92
8/22/2014	8:33:00	4.88	3686	2.4	6.83	420	0	8/25/2014	7:58:00	8.75	0	0	7.67	436	10.01
8/22/2014	8:34:00	4.88	3686	2.4	6.83	419	0	8/25/2014	7:59:00	8.65	0	0	7.68	435	10.02

8/22/2014	8:35:00	4.88	3686	2.4	6.82	419	0	8/25/2014	8:00:00	8.57	0	0	7.69	435	10.09
8/22/2014	8:36:00	4.87	3682	2.4	6.82	418	0	8/25/2014	8:01:00	8.49	0	0	7.68	435	10.12
8/22/2014	8:37:00	4.87	3676	2.4	6.82	418	0	8/25/2014	8:02:00	8.41	0	0	7.72	435	10.15
8/22/2014	8:38:00	4.88	3678	2.4	6.82	417	0	8/25/2014	8:03:00	8.35	0	0	7.73	435	10.23
8/22/2014	8:39:00	4.88	3675	2.4	6.82	417	0	8/25/2014	8:04:00	8.28	0	0	7.74	441	10.28
8/22/2014	8:40:00	4.87	3673	2.4	6.82	417	0	8/25/2014	8:05:00	8.22	0	0	7.75	434	10.25
8/22/2014	8:41:00	4.88	3668	2.3	6.82	416	0	8/25/2014	8:06:00	8.16	0	0	7.75	434	10.3
8/22/2014	8:42:00	4.89	3670	2.3	6.82	416	0	8/25/2014	8:07:00	8.11	0	0	7.76	434	10.34
8/22/2014	8:43:00	4.73	3671	2.3	6.82	415	0	8/25/2014	8:08:00	8.06	0	0	7.77	433	10.36
8/22/2014	8:44:00	4.87	3668	2.3	6.82	415	0	8/25/2014	8:09:00	8.02	0	0	7.78	433	10.34
8/22/2014	8:45:00	4.88	3665	2.3	6.82	414	0	8/25/2014	8:10:00	7.98	0	0	7.78	433	10.38
8/22/2014	8:46:00	4.87	3665	2.3	6.82	414	0	8/25/2014	8:11:00	7.93	0	0	7.79	438	10.4
8/22/2014	8:47:00	4.87	3663	2.3	6.82	414	0	8/25/2014	8:12:00	7.9	0	0	7.85	432	10.43
8/22/2014	8:48:00	4.88	3658	2.3	6.82	413	0	8/25/2014	8:13:00	3.61	6292	4	7.24	407	6.67
8/22/2014	8:49:00	4.88	3661	2.3	6.82	413	0	8/25/2014	8:14:00	4.19	5801	3.7	7.17	401	0
8/22/2014	8:50:00	4.89	3660	2.3	6.82	413	0	8/25/2014	8:15:00	4.59	5549	3.6	7.11	398	0
8/22/2014	8:51:00	4.88	3653	2.3	6.82	412	0	8/25/2014	8:16:00	4.75	5426	3.5	7.1	396	0
8/22/2014	8:52:00	4.88	3656	2.3	6.82	412	0	8/25/2014	8:17:00	4.84	5363	3.4	7.08	395	0
8/22/2014	8:53:00	4.88	3655	2.3	6.82	412	0	8/25/2014	8:18:00	4.83	5319	3.4	7.06	395	0
8/22/2014	8:54:00	4.87	3653	2.3	6.82	411	0	8/25/2014	8:19:00	4.83	5279	3.4	7.04	394	0
8/22/2014	8:55:00	4.87	3648	2.3	6.82	411	0	8/25/2014	8:20:00	4.81	5257	3.4	7.03	393	0
8/22/2014	8:56:00	4.87	3650	2.3	6.82	411	0	8/25/2014	8:21:00	4.79	5227	3.3	7.02	392	0
8/22/2014	8:57:00	4.87	3648	2.3	6.82	410	0	8/25/2014	8:22:00	4.89	5207	3.3	7.02	391	0
8/22/2014	8:58:00	4.87	3647	2.3	6.82	410	0	8/25/2014	8:23:00	4.9	5190	3.3	7.01	390	0
8/22/2014	8:59:00	4.86	3642	2.3	6.82	410	0	8/25/2014	8:24:00	4.92	5172	3.3	6.96	390	0
8/22/2014	9:00:00	4.86	3647	2.3	6.82	409	0	8/25/2014	8:25:00	4.92	5158	3.3	7	389	0
8/22/2014	9:01:00	4.86	3646	2.3	6.82	409	0	8/25/2014	8:26:00	4.93	5151	3.3	7	388	0
8/22/2014	9:02:00	4.87	3643	2.3	6.82	409	0	8/25/2014	8:27:00	4.93	5134	3.3	7	387	0
8/22/2014	9:03:00	4.85	3646	2.3	6.82	408	0	8/25/2014	8:28:00	4.93	5129	3.3	7	387	0
8/22/2014	9:04:00	4.85	3644	2.3	6.82	408	0	8/25/2014	8:29:00	4.92	5093	3.3	6.99	386	0

8/22/2014	9:05:00	4.85	3644	2.3	6.82	408	0	8/25/2014	8:30:00	4.94	5100	3.3	6.99	386	0
8/22/2014	9:06:00	4.75	3641	2.3	6.82	408	0	8/25/2014	8:31:00	4.81	5076	3.2	6.99	385	0
8/22/2014	9:07:00	4.84	3638	2.3	6.82	407	0	8/25/2014	8:32:00	4.83	5067	3.2	6.99	384	0
8/22/2014	9:08:00	4.74	3640	2.3	6.82	407	0	8/25/2014	8:33:00	4.89	5038	3.2	6.98	384	0
8/22/2014	9:09:00	4.83	3634	2.3	6.82	407	0	8/25/2014	8:34:00	4.9	5039	3.2	6.99	383	0
8/22/2014	9:10:00	4.84	3636	2.3	6.82	406	0	8/25/2014	8:35:00	4.9	5023	3.2	6.98	383	0
8/22/2014	9:11:00	4.84	3636	2.3	6.82	406	0	8/25/2014	8:36:00	4.91	5010	3.2	6.98	382	0
8/22/2014	9:12:00	4.83	3636	2.3	6.82	406	0	8/25/2014	8:37:00	4.91	4977	3.2	6.98	382	0
8/22/2014	9:13:00	4.85	3633	2.3	6.82	405	0	8/25/2014	8:38:00	4.9	4977	3.2	6.98	381	0
8/22/2014	9:14:00	4.82	3628	2.3	6.82	405	0	8/25/2014	8:39:00	4.9	4968	3.2	6.98	381	0
8/22/2014	9:15:00	4.82	3634	2.3	6.82	405	0	8/25/2014	8:40:00	4.9	4946	3.2	6.98	380	0
8/22/2014	9:16:00	4.83	3630	2.3	6.82	404	0	8/25/2014	8:41:00	4.9	4927	3.2	6.98	380	0
8/22/2014	9:17:00	4.82	3629	2.3	6.82	404	0	8/25/2014	8:42:00	4.9	4914	3.1	6.98	380	0
8/22/2014	9:18:00	4.82	3633	2.3	6.82	403	0	8/25/2014	8:43:00	4.9	4907	3.1	6.98	379	0
8/22/2014	9:19:00	4.83	3627	2.3	6.82	403	0	8/25/2014	8:44:00	4.9	4886	3.1	6.98	379	0
8/22/2014	9:20:00	4.81	3627	2.3	6.82	403	0	8/25/2014	8:45:00	4.91	4878	3.1	6.97	379	0
8/22/2014	9:21:00	4.84	3627	2.3	6.82	403	0	8/25/2014	8:46:00	4.84	4859	3.1	6.97	378	0
8/22/2014	9:22:00	4.83	3631	2.3	6.82	402	0	8/25/2014	8:47:00	4.82	4840	3.1	6.97	378	0
8/22/2014	9:23:00	4.84	3627	2.3	6.82	402	0	8/25/2014	8:48:00	4.89	4818	3.1	6.97	378	0
8/22/2014	9:24:00	4.83	3627	2.3	6.82	402	0	8/25/2014	8:49:00	4.89	4817	3.1	6.98	377	0
8/22/2014	9:25:00	4.83	3623	2.3	6.82	402	0	8/25/2014	8:50:00	4.9	4814	3.1	6.97	377	0
8/22/2014	9:26:00	4.83	3625	2.3	6.82	402	0	8/25/2014	8:51:00	4.91	4804	3.1	6.97	377	0
8/22/2014	9:27:00	4.84	3621	2.3	6.82	401	0	8/25/2014	8:52:00	4.91	4795	3.1	6.97	376	0
8/22/2014	9:28:00	4.85	3628	2.3	6.82	401	0	8/25/2014	8:53:00	4.92	4789	3.1	6.97	376	0
8/22/2014	9:29:00	4.85	3624	2.3	6.82	401	0	8/25/2014	8:54:00	4.92	4777	3.1	6.97	376	0
8/22/2014	9:30:00	4.88	3622	2.3	6.82	401	0	8/25/2014	8:55:00	4.92	4767	3.1	6.97	376	0
8/22/2014	9:31:00	4.67	3623	2.3	6.82	401	0	8/25/2014	8:56:00	4.93	4760	3	6.97	375	0
8/22/2014	9:32:00	4.63	3622	2.3	6.82	401	0	8/25/2014	8:57:00	4.93	4750	3	6.97	375	0
8/22/2014	9:33:00	4.8	3619	2.3	6.82	400	0	8/25/2014	8:58:00	4.93	4755	3	6.97	375	0
8/22/2014	9:34:00	4.81	3620	2.3	6.82	400	0	8/25/2014	8:59:00	4.93	4717	3	6.97	375	0

8/22/2014	9:35:00	4.82	3612	2.3	6.82	400	0	8/25/2014	9:00:00	4.94	4729	3	6.98	374	0
8/22/2014	9:36:00	4.82	3617	2.3	6.82	399	0	8/25/2014	9:01:00	4.93	4747	3	6.97	374	0
8/22/2014	9:37:00	4.84	3623	2.3	6.82	399	0	8/25/2014	9:02:00	4.8	4763	3	6.97	374	0
8/22/2014	9:38:00	4.84	3619	2.3	6.82	399	0	8/25/2014	9:03:00	4.92	4713	3	6.97	374	0
8/22/2014	9:39:00	4.84	3622	2.3	6.82	399	0	8/25/2014	9:04:00	4.92	4694	3	6.96	374	0
8/22/2014	9:40:00	4.83	3620	2.3	6.82	399	0	8/25/2014	9:05:00	4.93	4703	3	6.97	373	0
8/22/2014	9:41:00	4.83	3618	2.3	6.82	398	0	8/25/2014	9:06:00	4.94	4708	3	6.96	373	0
8/22/2014	9:42:00	4.84	3620	2.3	6.82	398	0	8/25/2014	9:07:00	4.94	4700	3	6.96	373	0
8/22/2014	9:43:00	4.84	3601	2.3	6.82	398	0	8/25/2014	9:08:00	4.94	4696	3	6.96	373	0
8/22/2014	9:44:00	4.84	3619	2.3	6.83	398	0	8/25/2014	9:09:00	4.95	4686	3	6.96	373	0
8/22/2014	9:45:00	4.84	3610	2.3	6.82	398	0	8/25/2014	9:10:00	4.95	4682	3	6.96	372	0
8/22/2014	9:46:00	4.84	3619	2.3	6.83	398	0	8/25/2014	9:11:00	4.95	4681	3	6.96	372	0
8/22/2014	9:47:00	4.85	3615	2.3	6.83	397	0	8/25/2014	9:12:00	4.95	4681	3	6.97	372	0
8/22/2014	9:48:00	4.85	3617	2.3	6.83	397	0	8/25/2014	9:13:00	4.94	4671	3	6.97	372	0
8/22/2014	9:49:00	4.86	3622	2.3	6.83	397	0	8/25/2014	9:14:00	4.95	4672	3	6.97	372	0
8/22/2014	9:50:00	4.86	3614	2.3	6.83	397	0	8/25/2014	9:15:00	4.95	4657	3	6.96	372	0
8/22/2014	9:51:00	4.87	3617	2.3	6.83	397	0	8/25/2014	9:16:00	4.85	4663	3	6.96	372	0
8/22/2014	9:52:00	4.86	3612	2.3	6.83	397	0	8/25/2014	9:17:00	4.88	4658	3	6.97	371	0
8/22/2014	9:53:00	4.87	3609	2.3	6.83	396	0	8/25/2014	9:18:00	4.94	4654	3	6.96	371	0
8/22/2014	9:54:00	4.86	3606	2.3	6.83	396	0	8/25/2014	9:19:00	4.95	4651	3	6.96	371	0
8/22/2014	9:55:00	4.86	3616	2.3	6.83	396	0	8/25/2014	9:20:00	4.95	4644	3	6.96	371	0
8/22/2014	9:56:00	4.86	3629	2.3	6.83	398	0	8/25/2014	9:21:00	4.95	4648	3	6.96	371	0
8/22/2014	9:57:00	4.75	3608	2.3	6.83	396	0	8/25/2014	9:22:00	4.96	4636	3	6.96	370	0
8/22/2014	9:58:00	4.79	3609	2.3	6.83	396	0	8/25/2014	9:23:00	4.95	4644	3	6.96	370	0
8/22/2014	9:59:00	4.74	3610	2.3	6.83	396	0	8/25/2014	9:24:00	4.95	4632	3	6.96	370	0
8/22/2014	10:00:00	4.85	3597	2.3	6.83	395	0	8/25/2014	9:25:00	4.95	4634	3	6.96	370	0
8/22/2014	10:01:00	4.68	3615	2.3	6.83	395	0	8/25/2014	9:26:00	4.95	4632	3	6.96	370	0
8/22/2014	10:02:00	4.81	3611	2.3	6.83	395	0	8/25/2014	9:27:00	4.95	4630	3	6.96	370	0
8/22/2014	10:03:00	4.79	3604	2.3	6.83	395	0	8/25/2014	9:28:00	4.95	4635	3	6.95	370	0

8/22/2014	10:04:00	4.83	3606	2.3	6.83	395	0	8/25/2014	9:29:00	4.96	4624	3	6.95	370	0
8/22/2014	10:05:00	4.85	3607	2.3	6.83	395	0	8/25/2014	9:30:00	5	4621	3	6.95	370	0
8/22/2014	10:06:00	4.85	3604	2.3	6.83	395	0	8/25/2014	9:31:00	4.82	4617	3	6.95	370	0
8/22/2014	10:07:00	4.88	3604	2.3	6.83	395	0	8/25/2014	9:32:00	4.9	4618	3	6.95	369	0
8/22/2014	10:08:00	4.69	3599	2.3	6.83	395	0	8/25/2014	9:33:00	4.95	4616	3	6.95	369	0
8/22/2014	10:09:00	4.67	3597	2.3	6.83	395	0	8/25/2014	9:34:00	4.97	4605	2.9	6.96	369	0
8/22/2014	10:10:00	4.81	3601	2.3	6.83	395	0	8/25/2014	9:35:00	4.94	4614	3	6.96	369	0
8/22/2014	10:11:00	4.88	3604	2.3	6.83	395	0	8/25/2014	9:36:00	4.96	4609	2.9	6.95	369	0
8/22/2014	10:12:00	4.63	3608	2.3	6.83	395	0	8/25/2014	9:37:00	4.96	4602	2.9	6.96	369	0
8/22/2014	10:13:00	4.84	3602	2.3	6.84	394	0	8/25/2014	9:38:00	4.93	4603	2.9	6.96	369	0
8/22/2014	10:14:00	4.84	3610	2.3	6.84	394	0	8/25/2014	9:39:00	4.97	4602	2.9	6.94	368	0
8/22/2014	10:15:00	4.86	3607	2.3	6.84	394	0	8/25/2014	9:40:00	4.98	4596	2.9	6.96	368	0
8/22/2014	10:16:00	4.87	3598	2.3	6.84	394	0	8/25/2014	9:41:00	4.98	4592	2.9	6.96	368	0
8/22/2014	10:17:00	4.64	3601	2.3	6.84	394	0	8/25/2014	9:42:00	4.99	4588	2.9	6.94	368	0
8/22/2014	10:18:00	4.81	3598	2.3	6.84	394	0	8/25/2014	9:43:00	5	4592	2.9	6.95	368	0
8/22/2014	10:19:00	4.89	3606	2.3	6.84	394	0	8/25/2014	9:44:00	5	4586	2.9	6.95	368	0
8/22/2014	10:20:00	4.64	3602	2.3	6.84	394	0	8/25/2014	9:45:00	5.05	4585	2.9	6.96	368	0
8/22/2014	10:21:00	4.77	3599	2.3	6.84	394	0	8/25/2014	9:46:00	4.83	4582	2.9	6.96	368	0
8/22/2014	10:22:00	4.85	3605	2.3	6.84	394	0	8/25/2014	9:47:00	4.84	4598	2.9	6.96	368	0
8/22/2014	10:23:00	4.64	3593	2.3	6.84	394	0	8/25/2014	9:48:00	4.94	4575	2.9	6.97	368	0
8/22/2014	10:24:00	4.73	3598	2.3	6.84	394	0	8/25/2014	9:49:00	4.98	4573	2.9	6.96	368	0
8/22/2014	10:25:00	4.87	3598	2.3	6.84	394	0	8/25/2014	9:50:00	4.99	4567	2.9	6.95	368	0
8/22/2014	10:26:00	4.65	3599	2.3	6.84	394	0	8/25/2014	9:51:00	5	4573	2.9	6.96	367	0
8/22/2014	10:27:00	4.81	3595	2.3	6.84	394	0	8/25/2014	9:52:00	5	4566	2.9	6.96	367	0

8/22/2014	10:28:00	4.75	3601	2.3	6.85	393	0	8/25/2014	9:53:00	4.99	4561	2.9	6.96	367	0
8/22/2014	10:29:00	4.7	3596	2.3	6.85	394	0	8/25/2014	9:54:00	4.97	4556	2.9	6.96	367	0
8/22/2014	10:30:00	4.84	3594	2.3	6.84	394	0	8/25/2014	9:55:00	5	4553	2.9	6.96	367	0
8/22/2014	10:31:00	4.84	3596	2.3	6.85	394	0	8/25/2014	9:56:00	4.97	4553	2.9	6.96	367	0
8/22/2014	10:32:00	4.84	3598	2.3	6.85	393	0	8/25/2014	9:57:00	4.98	4554	2.9	6.97	367	0
8/22/2014	10:33:00	4.83	3601	2.3	6.85	393	0	8/25/2014	9:58:00	4.98	4549	2.9	6.96	367	0
8/22/2014	10:34:00	4.84	3595	2.3	6.84	393	0	8/25/2014	9:59:00	4.98	4543	2.9	6.96	367	0
8/22/2014	10:35:00	4.85	3594	2.3	6.85	393	0	8/25/2014	10:00:00	5.05	4540	2.9	6.96	367	0
8/22/2014	10:36:00	4.86	3594	2.3	6.85	393	0	8/25/2014	10:01:00	4.87	4546	2.9	6.96	367	0
8/22/2014	10:37:00	4.86	3596	2.3	6.85	393	0	8/25/2014	10:02:00	4.94	4531	2.9	6.96	367	0
8/22/2014	10:38:00	4.86	3598	2.3	6.85	393	0	8/25/2014	10:03:00	4.99	4540	2.9	6.94	366	0
8/22/2014	10:39:00	4.87	3592	2.3	6.85	393	0	8/25/2014	10:04:00	4.99	4533	2.9	6.94	366	0
8/22/2014	10:40:00	4.87	3598	2.3	6.85	393	0	8/25/2014	10:05:00	5	4527	2.9	6.95	366	0
8/22/2014	10:41:00	4.86	3591	2.3	6.85	393	0	8/25/2014	10:06:00	4.99	4528	2.9	6.95	366	0
8/22/2014	10:42:00	4.87	3593	2.3	6.84	393	0	8/25/2014	10:07:00	5	4522	2.9	6.95	366	0
8/22/2014	10:43:00	4.87	3596	2.3	6.85	393	0	8/25/2014	10:08:00	5.02	4517	2.9	6.95	366	0
8/22/2014	10:44:00	4.88	3593	2.3	6.85	393	0	8/25/2014	10:09:00	5.01	4516	2.9	6.95	366	0
8/22/2014	10:45:00	4.74	3594	2.3	6.85	393	0	8/25/2014	10:10:00	5	4514	2.9	6.95	366	0
8/22/2014	10:46:00	4.78	3597	2.3	6.85	393	0	8/25/2014	10:11:00	5.01	4512	2.9	6.95	366	0
8/22/2014	10:47:00	4.89	3590	2.3	6.85	393	0	8/25/2014	10:12:00	5.01	4518	2.9	6.95	366	0
8/22/2014	10:48:00	4.9	3594	2.3	6.85	393	0	8/25/2014	10:13:00	5	4518	2.9	6.95	366	0
8/22/2014	10:49:00	4.9	3593	2.3	6.85	393	0	8/25/2014	10:14:00	5.01	4507	2.9	6.96	366	0
8/22/2014	10:50:00	4.9	3589	2.3	6.85	393	0	8/25/2014	10:15:00	5.02	4500	2.9	6.95	366	0
8/22/2014	10:51:00	4.9	3595	2.3	6.85	393	0	8/25/2014	10:16:00	4.96	4495	2.9	6.96	366	0

8/22/2014	10:52:00	4.92	3595	2.3	6.85	393	0	8/25/2014	10:17:00	4.96	4490	2.9	6.96	366	0
8/22/2014	10:53:00	4.92	3589	2.3	6.85	393	0	8/25/2014	10:18:00	5.01	4496	2.9	6.96	366	0
8/22/2014	10:54:00	4.92	3595	2.3	6.85	393	0	8/25/2014	10:19:00	5.01	4490	2.9	6.96	366	0
8/22/2014	10:55:00	4.95	3588	2.3	6.85	393	0	8/25/2014	10:20:00	5	4489	2.9	6.96	366	0
8/22/2014	10:56:00	4.95	3595	2.3	6.85	393	0	8/25/2014	10:21:00	5.01	4488	2.9	6.96	366	0
8/22/2014	10:57:00	4.94	3586	2.3	6.85	393	0	8/25/2014	10:22:00	5.01	4482	2.9	6.96	366	0
8/22/2014	10:58:00	4.92	3587	2.3	6.85	393	0	8/25/2014	10:23:00	5.02	4487	2.9	6.96	366	0
8/22/2014	10:59:00	4.9	3587	2.3	6.85	392	0	8/25/2014	10:24:00	5.03	4485	2.9	6.95	366	0
8/22/2014	11:00:00	4.89	3585	2.3	6.85	392	0	8/25/2014	10:25:00	5.02	4469	2.9	6.95	366	0
8/22/2014	11:01:00	4.91	3586	2.3	6.85	392	0	8/25/2014	10:26:00	5.01	4472	2.9	6.95	365	0
8/22/2014	11:02:00	4.9	3591	2.3	6.85	392	0	8/25/2014	10:27:00	5.01	4467	2.9	6.95	365	0
8/22/2014	11:03:00	4.89	3585	2.3	6.85	392	0	8/25/2014	10:28:00	5.02	4462	2.9	6.95	365	0
8/22/2014	11:04:00	4.91	3589	2.3	6.85	392	0	8/25/2014	10:29:00	5.01	4467	2.9	6.96	365	0
8/22/2014	11:05:00	4.9	3590	2.3	6.85	392	0	8/25/2014	10:30:00	5.01	4459	2.9	6.96	365	0
8/22/2014	11:06:00	4.94	3593	2.3	6.85	392	0	8/25/2014	10:31:00	4.9	4454	2.9	6.97	365	0
8/22/2014	11:07:00	4.9	3591	2.3	6.85	392	0	8/25/2014	10:32:00	4.95	4444	2.8	6.95	365	0
8/22/2014	11:08:00	4.93	3582	2.3	6.85	392	0	8/25/2014	10:33:00	4.99	4454	2.9	6.95	365	0
8/22/2014	11:09:00	4.93	3589	2.3	6.85	392	0	8/25/2014	10:34:00	5.01	4448	2.8	6.96	365	0
8/22/2014	11:10:00	4.9	3586	2.3	6.85	392	0	8/25/2014	10:35:00	5.01	4446	2.8	6.96	365	0
8/22/2014	11:11:00	4.9	3583	2.3	6.86	392	0	8/25/2014	10:36:00	5.02	4440	2.8	6.96	365	0
8/22/2014	11:12:00	4.89	3595	2.3	6.86	392	0	8/25/2014	10:37:00	4.99	4442	2.8	6.96	365	0
8/22/2014	11:13:00	4.91	3591	2.3	6.86	392	0	8/25/2014	10:38:00	4.99	4433	2.8	6.95	365	0
8/22/2014	11:14:00	4.91	3585	2.3	6.86	392	0	8/25/2014	10:39:00	5.01	4432	2.8	6.96	365	0
8/22/2014	11:15:00	4.91	3588	2.3	6.85	392	0	8/25/2014	10:40:00	5	4431	2.8	6.95	365	0

8/22/2014	11:16:00	4.91	3595	2.3	6.86	392	0	8/25/2014	10:41:00	4.94	4428	2.8	6.96	365	0
8/22/2014	11:17:00	4.91	3590	2.3	6.86	392	0	8/25/2014	10:42:00	4.99	4427	2.8	6.96	365	0
8/22/2014	11:18:00	4.91	3586	2.3	6.86	392	0	8/25/2014	10:43:00	5.02	4421	2.8	6.95	365	0
8/22/2014	11:19:00	4.9	3585	2.3	6.86	392	0	8/25/2014	10:44:00	5.01	4424	2.8	6.96	365	0
8/22/2014	11:20:00	4.9	3588	2.3	6.86	392	0	8/25/2014	10:45:00	4.97	4416	2.8	6.96	365	0
8/22/2014	11:21:00	4.9	3590	2.3	6.86	391	0	8/25/2014	10:46:00	4.87	4416	2.8	6.95	365	0
8/22/2014	11:22:00	4.89	3590	2.3	6.86	391	0	8/25/2014	10:47:00	4.95	4413	2.8	6.96	365	0
8/22/2014	11:23:00	4.89	3590	2.3	6.86	391	0	8/25/2014	10:48:00	4.99	4402	2.8	6.95	365	0
8/22/2014	11:24:00	4.9	3581	2.3	6.86	391	0	8/25/2014	10:49:00	5.07	4405	2.8	6.96	365	0
8/22/2014	11:25:00	4.9	3588	2.3	6.86	391	0	8/25/2014	10:50:00	5.01	4403	2.8	6.96	365	0
8/22/2014	11:26:00	4.89	3588	2.3	6.86	391	0	8/25/2014	10:51:00	5.06	4393	2.8	6.96	365	0
8/22/2014	11:27:00	4.89	3583	2.3	6.86	391	0	8/25/2014	10:52:00	5.02	4395	2.8	6.96	365	0
8/22/2014	11:28:00	4.88	3591	2.3	6.86	391	0	8/25/2014	10:53:00	5	4381	2.8	6.96	365	0
8/22/2014	11:29:00	4.88	3587	2.3	6.86	391	0	8/25/2014	10:54:00	5.04	4388	2.8	6.96	365	0
8/22/2014	11:30:00	4.88	3582	2.3	6.86	391	0	8/25/2014	10:55:00	5	4384	2.8	6.96	365	0
8/22/2014	11:31:00	4.89	3583	2.3	6.86	391	0	8/25/2014	10:56:00	5.06	4386	2.8	6.96	365	0
8/22/2014	11:32:00	4.89	3581	2.3	6.86	391	0	8/25/2014	10:57:00	5.02	4386	2.8	6.96	365	0
8/22/2014	11:33:00	4.89	3587	2.3	6.86	391	0	8/25/2014	10:58:00	5	4380	2.8	6.96	365	0
8/22/2014	11:34:00	4.9	3579	2.3	6.86	391	0	8/25/2014	10:59:00	5.04	4373	2.8	6.97	365	0
8/22/2014	11:35:00	4.77	3580	2.3	6.86	391	0	8/25/2014	11:00:00	5.1	4379	2.8	6.96	365	0
8/22/2014	11:36:00	4.86	3585	2.3	6.86	391	0	8/25/2014	11:01:00	4.96	4363	2.8	6.96	365	0
8/22/2014	11:37:00	4.88	3582	2.3	6.86	390	0	8/25/2014	11:02:00	4.97	4369	2.8	6.96	365	0
8/22/2014	11:38:00	4.86	3584	2.3	6.86	390	0	8/25/2014	11:03:00	5.08	4369	2.8	6.96	365	0
8/22/2014	11:39:00	4.86	3578	2.3	6.86	390	0	8/25/2014	11:04:00	5.07	4355	2.8	6.96	365	0

8/22/2014	11:40:00	4.87	3585	2.3	6.86	390	0	8/25/2014	11:05:00	5.07	4355	2.8	6.96	365	0
8/22/2014	11:41:00	4.87	3584	2.3	6.86	390	0	8/25/2014	11:06:00	5.09	4353	2.8	7	365	0
8/22/2014	11:42:00	4.87	3585	2.3	6.86	390	0	8/25/2014	11:07:00	5.08	4348	2.8	6.96	365	0
8/22/2014	11:43:00	4.89	3576	2.3	6.86	390	0	8/25/2014	11:08:00	5.09	4349	2.8	6.96	365	0
8/22/2014	11:44:00	6.1	6	0	7.24	389	7.69	8/25/2014	11:09:00	5.07	4355	2.8	6.96	365	0
8/22/2014	11:45:00	5.91	1	0	7.38	388	10.5	8/25/2014	11:10:00	5.08	4349	2.8	6.96	365	0
8/22/2014	11:46:00	6.04	0	0	7.51	386	10.67	8/25/2014	11:11:00	5.08	4349	2.8	6.96	365	0
8/22/2014	11:47:00	6.22	0	0	7.59	384	10.65	8/25/2014	11:12:00	5.08	4342	2.8	6.96	365	0
8/22/2014	11:48:00	6.41	0	0	7.65	385	10.66	8/25/2014	11:13:00	5.05	4345	2.8	6.96	365	0
8/22/2014	11:49:00	6.59	0	0	7.7	384	10.6	8/25/2014	11:14:00	5.07	4340	2.8	6.96	365	0
8/22/2014	11:50:00	6.77	0	0	7.74	385	10.62	8/25/2014	11:15:00	5.05	4333	2.8	6.96	365	0
8/22/2014	11:51:00	6.94	0	0	7.77	384	10.55	8/25/2014	11:16:00	4.97	4344	2.8	6.96	365	0
8/22/2014	11:52:00	7.1	0	0	7.77	384	10.56	8/25/2014	11:17:00	5.02	4326	2.8	6.96	365	0
8/22/2014	11:53:00	7.25	0	0	7.77	383	10.53	8/25/2014	11:18:00	5.09	4326	2.8	6.96	365	0
8/22/2014	11:54:00	7.39	0	0	7.77	384	10.47	8/25/2014	11:19:00	5.08	4328	2.8	6.96	365	0
8/22/2014	11:55:00	7.53	0	0	7.76	385	10.46	8/25/2014	11:20:00	5.11	4320	2.8	6.96	365	0
8/22/2014	11:56:00	7.66	0	0	7.75	385	10.41	8/25/2014	11:21:00	5.1	4319	2.8	6.96	365	0
8/22/2014	11:57:00	7.78	0	0	7.74	386	10.4	8/25/2014	11:22:00	5.09	4319	2.8	6.96	365	0
8/22/2014	11:58:00	7.9	0	0	7.73	386	10.38	8/25/2014	11:23:00	5.07	4318	2.8	6.96	365	0
8/22/2014	11:59:00	8.02	0	0	7.71	386	10.34	8/25/2014	11:24:00	5.05	4313	2.8	6.94	365	0
8/22/2014	12:00:00	8.13	0	0	7.7	386	10.6	8/25/2014	11:25:00	5.09	4317	2.8	6.96	365	0
8/22/2014	12:01:00	8.23	0	0	7.68	386	10.52	8/25/2014	11:26:00	5.13	4303	2.8	6.96	366	0
8/22/2014	12:02:00	8.33	0	0	7.67	388	10.49	8/25/2014	11:27:00	5.09	4312	2.8	6.97	366	0
8/22/2014	12:03:00	8.42	0	0	7.65	389	10.45	8/25/2014	11:28:00	5.09	4306	2.8	6.96	366	0

8/22/2014	12:04:00	8.5	0	0	7.63	389	10.42	8/25/2014	11:29:00	5.09	4293	2.7	6.96	366	0
8/22/2014	12:05:00	8.58	0	0	7.61	389	10.44	8/25/2014	11:30:00	5.09	4297	2.7	6.96	366	0
8/22/2014	12:06:00	8.65	0	0	7.59	390	10.37	8/25/2014	11:31:00	5.03	4297	2.8	6.96	366	0
8/22/2014	12:07:00	8.72	0	0	7.58	390	10.46	8/25/2014	11:32:00	5.06	4297	2.7	6.96	366	0
8/22/2014	12:08:00	8.78	0	0	7.56	390	10.38	8/25/2014	11:33:00	5.07	4296	2.7	6.96	366	0
8/22/2014	12:09:00	8.84	0	0	7.55	391	10.36	8/25/2014	11:34:00	5.08	4287	2.7	6.96	366	0
8/22/2014	12:10:00	8.89	0	0	7.54	391	10.31	8/25/2014	11:35:00	5.14	4288	2.7	6.96	366	0
8/22/2014	12:11:00	8.94	0	0	7.52	392	10.32	8/25/2014	11:36:00	5.09	4293	2.7	6.96	366	0
8/22/2014	12:12:00	8.98	0	0	7.51	393	10.32	8/25/2014	11:37:00	5.1	4288	2.7	6.96	366	0
8/22/2014	12:13:00	9.03	0	0	7.51	393	10.27	8/25/2014	11:38:00	5.14	4288	2.7	6.96	366	0
8/22/2014	12:14:00	9.07	0	0	7.5	392	10.27	8/25/2014	11:39:00	5.13	4282	2.7	6.95	366	0
8/22/2014	12:15:00	9.1	0	0	7.49	393	10.26	8/25/2014	11:40:00	5.13	4281	2.7	6.95	366	0
8/22/2014	12:16:00	9.13	0	0	7.48	393	10.25	8/25/2014	11:41:00	5.19	4274	2.7	6.95	366	0
8/22/2014	12:17:00	9.16	0	0	7.47	394	10.24	8/25/2014	11:42:00	5.12	4275	2.7	6.96	366	0
8/22/2014	12:18:00	9.2	0	0	7.47	395	10.25	8/25/2014	11:43:00	5.15	4273	2.7	6.95	366	0
8/22/2014	12:19:00	9.22	0	0	7.46	396	10.26	8/25/2014	11:44:00	5.1	4266	2.7	6.97	366	0
8/22/2014	12:20:00	9.26	0	0	7.46	396	10.23	8/25/2014	11:45:00	5.05	4271	2.7	6.94	366	0
8/22/2014	12:21:00	6.21	6826	4.4	7.24	420	3.12	8/25/2014	11:46:00	4.96	4268	2.7	6.96	366	0
8/22/2014	12:22:00	6.1	6834	4.4	7.2	412	1.71	8/25/2014	11:47:00	4.99	4259	2.7	6.95	366	0
8/22/2014	12:23:00	6.02	6832	4.4	7.2	413	1.76	8/25/2014	11:48:00	5.13	4266	2.7	6.95	366	0
8/22/2014	12:24:00	6.14	5803	3.7	7.16	413	1.76	8/25/2014	11:49:00	5.17	4258	2.7	6.98	366	0
8/22/2014	12:25:00	6.02	6827	4.4	7.21	414	1.75	8/25/2014	11:50:00	5.18	4262	2.7	6.95	366	0
8/22/2014	12:26:00	5.99	6830	4.4	7.22	414	1.74	8/25/2014	11:51:00	5.12	4254	2.7	6.95	366	0
8/22/2014	12:27:00	5.95	6817	4.4	7.22	414	1.77	8/25/2014	11:52:00	5.18	4256	2.7	6.95	366	0

8/22/2014	12:28:00	5.94	6830	4.4	7.23	415	1.76	8/25/2014	11:53:00	5.16	4257	2.7	6.95	366	0
8/22/2014	12:29:00	5.95	6827	4.4	7.24	415	1.74	8/25/2014	11:54:00	5.14	4247	2.7	6.96	366	0
8/22/2014	12:30:00	5.96	6822	4.4	7.24	416	1.74	8/25/2014	11:55:00	5.13	4243	2.7	6.95	367	0
8/22/2014	12:31:00	6	6825	4.4	7.25	416	1.72	8/25/2014	11:56:00	5.16	4249	2.7	6.96	367	0
8/22/2014	12:32:00	6	6827	4.4	7.26	417	1.7	8/25/2014	11:57:00	5.12	4227	2.7	6.95	367	0
8/22/2014	12:33:00	6.06	6809	4.4	7.27	416	1.71	8/25/2014	11:58:00	5.14	4243	2.7	6.95	367	0
8/22/2014	12:34:00	6.03	6823	4.4	7.29	417	1.7	8/25/2014	11:59:00	5.18	4239	2.7	6.95	367	0
8/22/2014	12:35:00	6.02	6818	4.4	7.3	418	1.71	8/25/2014	12:00:00	5.29	4240	2.7	6.95	367	0
8/22/2014	12:36:00	6.02	6814	4.4	7.3	418	1.72	8/25/2014	12:01:00	5.1	4243	2.7	6.95	367	0
8/22/2014	12:37:00	6.05	6816	4.4	7.31	419	1.72	8/25/2014	12:02:00	5.12	4233	2.7	6.95	367	0
8/22/2014	12:38:00	6.03	6826	4.4	7.32	419	1.73	8/25/2014	12:02:00	5.12	4233	2.7	6.95	367	0
8/22/2014	12:39:00	6	6815	4.4	7.33	420	1.74	8/25/2014	12:03:00	5.13	4235	2.7	6.96	367	0
8/22/2014	12:40:00	6.03	6795	4.3	7.34	420	1.71	8/25/2014	12:04:00	5.17	4230	2.7	6.95	367	0
8/22/2014	12:41:00	6.04	6826	4.4	7.35	420	1.68	8/25/2014	12:05:00	5.17	4228	2.7	6.95	367	0
8/22/2014	12:42:00	6.03	6817	4.4	7.36	421	1.7	8/25/2014	12:06:00	5.16	4234	2.7	6.95	367	0
8/22/2014	12:43:00	6.03	6825	4.4	7.37	421	1.74	8/25/2014	12:07:00	5.2	4233	2.7	6.95	367	0
8/22/2014	12:44:00	6.01	6826	4.4	7.38	422	1.69	8/25/2014	12:08:00	5.2	4222	2.7	6.95	367	0
8/22/2014	12:45:00	6.01	6806	4.4	7.39	422	1.69	8/25/2014	12:09:00	5.21	4219	2.7	6.95	367	0
8/22/2014	12:46:00	6.02	6821	4.4	7.4	422	1.67	8/25/2014	12:10:00	5.33	4216	2.7	6.9	367	0
8/22/2014	12:47:00	6.04	6809	4.4	7.4	423	1.63	8/25/2014	12:11:00	5.23	4221	2.7	6.94	367	0
8/22/2014	12:48:00	6.08	6813	4.4	7.42	423	1.59	8/25/2014	12:12:00	5.27	4217	2.7	6.95	368	0
8/22/2014	12:49:00	6.09	6807	4.4	7.42	423	1.55	8/25/2014	12:13:00	5.17	4220	2.7	6.95	368	0
8/22/2014	12:50:00	6.12	6810	4.4	7.43	424	1.52	8/25/2014	12:14:00	5.11	4209	2.7	6.95	368	0
8/22/2014	12:51:00	6.19	6823	4.4	7.44	424	1.52	8/25/2014	12:15:00	5.1	4219	2.7	6.95	368	0

8/22/2014	12:52:00	6.2	6807	4.4	7.45	424	1.49	8/25/2014	12:16:00	5.01	4214	2.7	6.95	368	0
8/22/2014	12:53:00	6.18	6813	4.4	7.45	425	1.53	8/25/2014	12:17:00	5.06	4210	2.7	6.96	368	0
8/22/2014	12:54:00	6.21	6810	4.4	7.45	425	1.53	8/25/2014	12:18:00	5.16	4209	2.7	6.92	368	0
8/22/2014	12:55:00	6.25	6824	4.4	7.45	426	1.54	8/25/2014	12:19:00	5.17	4200	2.7	6.95	368	0
8/22/2014	12:56:00	6.27	6811	4.3	7.45	427	1.55	8/25/2014	12:20:00	5.18	4189	2.7	6.95	368	0
8/22/2014	12:57:00	6.3	6809	4.4	7.44	427	1.55	8/25/2014	12:21:00	5.12	4204	2.7	6.95	368	0
8/22/2014	12:58:00	6.31	6805	4.4	7.45	428	1.56	8/25/2014	12:22:00	5.2	4205	2.7	6.95	368	0
8/22/2014	12:59:00	6.21	6822	4.4	7.45	429	1.64	8/25/2014	12:23:00	5.18	4198	2.7	6.95	368	0
8/22/2014	13:00:00	6.2	6802	4.4	7.46	429	1.68	8/25/2014	12:24:00	5.22	4197	2.7	6.95	368	0
8/22/2014	13:01:00	6.21	6807	4.4	7.47	430	1.74	8/25/2014	12:25:00	5.17	4200	2.7	6.95	368	0
8/22/2014	13:02:00	6.25	6813	4.4	7.47	430	1.77	8/25/2014	12:26:00	5.2	4195	2.7	6.96	368	0
8/22/2014	13:03:00	6.26	6788	4.3	7.48	431	1.82	8/25/2014	12:27:00	5.18	4185	2.7	6.95	368	0
8/22/2014	13:04:00	6.29	6817	4.4	7.48	432	1.87	8/25/2014	12:28:00	5.21	4191	2.7	6.95	368	0
8/22/2014	13:05:00	6.31	6822	4.4	7.49	432	1.87	8/25/2014	12:29:00	5.16	4189	2.7	6.96	368	0
8/22/2014	13:06:00	6.29	6808	4.4	7.5	433	1.9	8/25/2014	12:30:00	5.23	4185	2.7	6.95	368	0
8/22/2014	13:07:00	6.28	6815	4.4	7.5	433	1.93	8/25/2014	12:31:00	5.18	4191	2.7	6.96	369	0
8/22/2014	13:08:00	6.29	6807	4.4	7.51	434	1.97	8/25/2014	12:32:00	5.16	4186	2.7	6.95	369	0
8/22/2014	13:09:00	6.31	6811	4.4	7.51	434	2.01	8/25/2014	12:33:00	5.24	4190	2.7	6.96	369	0
8/22/2014	13:10:00	6.3	6810	4.4	7.52	435	2.07	8/25/2014	12:34:00	5.33	4184	2.7	6.96	369	0
8/22/2014	13:11:00	6.27	6823	4.4	7.53	435	2.09	8/25/2014	12:35:00	5.26	4173	2.7	6.95	369	0
8/22/2014	13:12:00	6.26	6781	4.3	7.54	436	2.13	8/25/2014	12:36:00	5.21	4183	2.7	6.96	369	0
8/22/2014	13:13:00	6.24	6808	4.4	7.54	436	2.13	8/25/2014	12:37:00	5.17	4178	2.7	6.96	369	0
8/22/2014	13:14:00	6.27	6824	4.4	7.55	437	2.14	8/25/2014	12:38:00	5.14	4180	2.7	6.96	369	0
8/22/2014	13:15:00	6.3	6809	4.4	7.55	437	2.13	8/25/2014	12:39:00	5.21	4176	2.7	6.96	369	0

8/22/2014	13:16:00	6.32	6824	4.4	7.56	438	2.1	8/25/2014	12:40:00	5.22	4173	2.7	6.96	369	0
8/22/2014	13:17:00	6.33	6815	4.4	7.57	439	2.1	8/25/2014	12:41:00	5.2	4174	2.7	6.96	369	0
8/22/2014	13:18:00	6.38	6796	4.3	7.57	439	2.08	8/25/2014	12:42:00	5.24	4169	2.7	6.96	369	0
8/22/2014	13:19:00	6.39	6819	4.4	7.58	440	2.08	8/25/2014	12:43:00	5.27	4170	2.7	6.96	369	0
8/22/2014	13:20:00	6.37	6818	4.4	7.59	441	2.07	8/25/2014	12:44:00	5.12	4164	2.7	6.96	369	0
8/22/2014	13:21:00	6.39	6748	4.3	7.6	441	2.08	8/25/2014	12:45:00	5.2	4167	2.7	6.96	369	0
8/22/2014	13:22:00	6.38	6818	4.4	7.6	442	2.07	8/25/2014	12:46:00	4.99	4176	2.7	6.96	369	0
8/22/2014	13:23:00	6.45	6816	4.4	7.63	440	2.06	8/25/2014	12:47:00	5.11	4165	2.7	6.96	369	0
8/22/2014	13:24:00	6.4	6816	4.4	7.65	441	1.98	8/25/2014	12:48:00	5.14	4169	2.7	6.94	369	0
8/22/2014	13:25:00	6.37	6809	4.4	7.65	443	1.99	8/25/2014	12:49:00	5.22	4172	2.7	6.95	369	0
8/22/2014	13:26:00	6.38	6807	4.4	7.66	443	1.95	8/25/2014	12:50:00	5.33	4168	2.7	6.95	369	0
8/22/2014	13:27:00	6.38	6815	4.4	7.66	443	1.91	8/25/2014	12:51:00	5.3	4161	2.7	6.95	369	0
8/22/2014	13:28:00	6.37	6809	4.4	7.67	443	1.86	8/25/2014	12:52:00	5.42	4164	2.7	6.95	369	0
8/22/2014	13:29:00	6.34	6807	4.4	7.68	444	1.81	8/25/2014	12:53:00	5.53	4156	2.7	6.95	369	0
8/22/2014	13:30:00	6.37	6823	4.4	7.69	444	1.77	8/25/2014	12:54:00	5.32	4159	2.7	6.95	369	0
8/22/2014	13:31:00	6.36	6810	4.4	7.69	445	1.72	8/25/2014	12:55:00	5.31	4165	2.7	6.95	369	0
8/22/2014	13:32:00	6.37	6811	4.4	7.7	445	1.66	8/25/2014	12:56:00	5.43	4155	2.7	6.95	369	0
8/22/2014	13:33:00	6.37	6808	4.4	7.7	445	1.6	8/25/2014	12:57:00	5.43	4153	2.7	6.95	369	0
8/22/2014	13:34:00	6.37	6824	4.4	7.71	446	1.55	8/25/2014	12:58:00	5.39	4157	2.7	6.95	369	0
8/22/2014	13:35:00	6.38	6784	4.3	7.72	446	1.51	8/25/2014	12:59:00	5.52	4152	2.7	6.95	370	0
8/22/2014	13:36:00	6.38	6810	4.4	7.73	446	1.46	8/25/2014	13:00:00	5.34	4153	2.7	6.95	370	0
8/22/2014	13:37:00	6.38	6802	4.4	7.74	447	1.43	8/25/2014	13:01:00	5.32	4152	2.7	6.95	369	0
8/22/2014	13:38:00	6.37	6806	4.4	7.74	447	1.38	8/25/2014	13:02:00	5.27	4143	2.7	6.95	369	0
8/22/2014	13:39:00	6.38	6820	4.4	7.75	447	1.37	8/25/2014	13:03:00	5.38	4155	2.7	6.95	370	0

8/22/2014	13:40:00	6.37	6819	4.4	7.76	447	1.38	8/25/2014	13:04:00	5.38	4149	2.7	6.95	370	0
8/22/2014	13:41:00	6.39	6818	4.4	7.77	448	1.41	8/25/2014	13:05:00	5.4	4150	2.7	6.95	370	0
8/22/2014	13:42:00	6.4	6810	4.4	7.77	448	1.41	8/25/2014	13:06:00	5.31	4157	2.7	6.95	370	0
8/22/2014	13:43:00	6.41	6814	4.4	7.78	448	1.44	8/25/2014	13:07:00	5.49	4156	2.7	6.95	370	0
8/22/2014	13:44:00	6.39	6716	4.3	7.79	448	1.45	8/25/2014	13:08:00	5.6	4148	2.7	6.95	370	0
8/22/2014	13:45:00	6.4	6820	4.4	7.8	449	1.46	8/25/2014	13:09:00	5.41	4148	2.7	6.95	370	0
8/22/2014	13:46:00	6.42	6809	4.4	7.81	449	1.45	8/25/2014	13:10:00	5.3	4154	2.7	6.95	370	0
8/22/2014	13:47:00	6.42	6777	4.3	7.81	449	1.44	8/25/2014	13:11:00	5.34	4149	2.7	6.95	370	0
8/22/2014	13:48:00	6.45	6818	4.4	7.85	448	2.26	8/25/2014	13:12:00	5.33	4148	2.7	6.95	370	0
8/22/2014	13:49:00	6.46	6805	4.4	7.84	448	1.41	8/25/2014	13:13:00	5.23	4145	2.7	6.95	370	0
8/22/2014	13:50:00	6.49	6804	4.4	7.84	449	1.48	8/25/2014	13:14:00	5.16	4145	2.7	6.94	370	0
8/22/2014	13:51:00	6.5	6817	4.4	7.83	450	1.49	8/25/2014	13:15:00	5.16	4147	2.7	6.95	370	0
8/22/2014	13:52:00	6.52	6812	4.4	7.83	450	1.49	8/25/2014	13:16:00	5.25	4153	2.7	6.95	370	0
8/22/2014	13:53:00	6.52	6769	4.3	7.83	451	1.52	8/25/2014	13:17:00	5.32	4150	2.7	6.94	370	0
8/22/2014	13:54:00	6.53	6822	4.4	7.83	451	1.51	8/25/2014	13:18:00	5.29	4147	2.7	6.96	370	0
8/22/2014	13:55:00	6.58	6770	4.3	7.83	451	1.51	8/25/2014	13:19:00	5.31	4169	2.7	6.94	370	0
8/22/2014	13:56:00	6.61	6816	4.4	7.83	452	1.52	8/25/2014	13:20:00	5.46	4148	2.7	6.95	370	0
8/22/2014	13:57:00	6.6	6806	4.4	7.83	452	1.52	8/25/2014	13:21:00	5.39	4150	2.7	6.98	370	0
8/22/2014	13:58:00	6.61	6818	4.4	7.82	453	1.52	8/25/2014	13:22:00	5.31	4153	2.7	6.97	370	0
8/22/2014	13:59:00	6.6	6793	4.3	7.83	453	1.53	8/25/2014	13:23:00	5.4	4141	2.7	6.96	370	0
8/22/2014	14:00:00	6.6	6807	4.4	7.82	453	1.54	8/25/2014	13:24:00	5.23	4149	2.7	6.96	370	0
8/22/2014	14:01:00	6.61	6806	4.4	7.83	454	1.54	8/25/2014	13:25:00	5.17	4140	2.6	6.96	370	0
8/22/2014	14:02:00	6.61	6802	4.4	7.82	454	1.54	8/25/2014	13:26:00	5.28	4148	2.7	6.96	370	0
8/22/2014	14:03:00	6.56	6817	4.3	7.82	455	1.56	8/25/2014	13:27:00	5.21	4140	2.6	6.96	370	0

8/22/2014	14:04:00	6.51	6817	4.4	7.82	455	1.57	8/25/2014	13:28:00	5.3	4147	2.7	6.94	370	0
8/22/2014	14:05:00	6.59	6749	4.3	7.82	455	1.58	8/25/2014	13:29:00	5.29	4144	2.7	6.96	370	0
8/22/2014	14:06:00	6.58	6797	4.4	7.82	456	1.59	8/25/2014	13:30:00	5.16	4139	2.6	6.96	370	0
8/22/2014	14:07:00	6.59	5793	3.7	7.79	457	2.68	8/25/2014	13:31:00	5.14	4136	2.6	6.95	370	0
8/22/2014	14:08:00	6.75	1	0	7.86	456	10.05	8/25/2014	13:32:00	5.19	4138	2.6	6.95	370	0
8/22/2014	14:09:00	6.92	0	0	7.98	456	10.09	8/25/2014	13:34:00	5.13	4140	2.6	6.95	370	0
8/22/2014	14:10:00	7.09	0	0	8.05	456	10.09	8/25/2014	13:35:00	5.16	4140	2.6	6.95	370	0
8/22/2014	14:11:00	6.82	6801	4.4	7.97	456	5.24	8/25/2014	13:36:00	5.12	4133	2.6	6.95	370	0
8/22/2014	14:12:00	6.8	6806	4.4	7.91	457	1.54	8/25/2014	13:37:00	5.16	4141	2.6	6.95	370	0
8/22/2014	14:13:00	6.58	6802	4.4	7.9	461	1.63	8/25/2014	13:38:00	5.15	4138	2.6	6.95	370	0
8/22/2014	14:14:00	6.56	6779	4.3	7.89	461	1.62	8/25/2014	13:39:00	5.22	4132	2.6	6.98	370	0
8/22/2014	14:15:00	6.59	6800	4.4	7.88	461	1.63	8/25/2014	13:40:00	5.42	4150	2.7	6.95	370	0
8/22/2014	14:16:00	6.61	6817	4.4	7.88	461	1.64	8/25/2014	13:41:00	5.34	4138	2.6	6.95	370	0
8/22/2014	14:17:00	6.61	6818	4.4	7.87	461	1.62	8/25/2014	13:42:00	5.32	4131	2.6	6.95	370	0
8/22/2014	14:18:00	6.62	6810	4.4	7.87	462	1.61	8/25/2014	13:43:00	5.35	4130	2.6	6.95	371	0
8/22/2014	14:19:00	6.63	6805	4.4	7.87	462	1.61	8/25/2014	13:44:00	5.29	4133	2.6	6.95	371	0
8/22/2014	14:20:00	6.61	6812	4.4	7.87	462	1.63	8/25/2014	13:45:00	5.51	4114	2.6	6.97	371	0
8/22/2014	14:21:00	6.59	6808	4.4	7.87	462	1.61	8/25/2014	13:46:00	5.33	4133	2.6	6.95	371	0
8/22/2014	14:22:00	6.68	6802	4.4	7.88	462	1.81	8/25/2014	13:47:00	5.28	4132	2.6	6.95	371	0
8/22/2014	14:23:00	6.66	6818	4.4	7.87	462	1.58	8/25/2014	13:48:00	5.21	4125	2.6	6.95	371	0
8/22/2014	14:24:00	6.65	6808	4.4	7.89	464	2.22	8/25/2014	13:49:00	5.24	4130	2.6	6.96	370	0
8/22/2014	14:25:00	6.68	26	0	7.98	460	8.11	8/25/2014	13:50:00	5.4	4129	2.6	6.95	370	0
8/22/2014	14:26:00	6.82	0	0	7.97	462	10.13	8/25/2014	13:51:00	5.4	4126	2.6	6.95	371	0
8/22/2014	14:27:00	6.96	0	0	8.04	462	10.06	8/25/2014	13:52:00	5.31	4119	2.6	6.95	371	0

8/22/2014	14:28:00	7.09	0	0	8.09	462	10.04	8/25/2014	13:53:00	5.38	4125	2.6	6.95	371	0
8/22/2014	14:29:00	7.19	0	0	8.13	462	9.98	8/25/2014	13:54:00	5.47	4118	2.6	6.95	371	0
								8/25/2014	13:55:00	5.38	4125	2.6	6.95	371	0
								8/25/2014	13:56:00	5.35	4124	2.6	6.95	371	0
								8/25/2014	13:57:00	5.31	4123	2.6	6.95	371	0
								8/25/2014	13:58:00	5.33	4119	2.6	6.97	371	0
								8/25/2014	13:59:00	5.15	4120	2.6	6.96	371	0
								8/25/2014	14:00:00	5.14	4122	2.6	6.95	371	0
								8/25/2014	14:01:00	5.45	4124	2.6	6.97	371	0
								8/25/2014	14:02:00	5.45	4121	2.6	6.95	371	0
								8/25/2014	14:03:00	5.52	4120	2.6	6.95	371	0
								8/25/2014	14:04:00	5.59	4119	2.6	6.96	372	0
								8/25/2014	14:05:00	5.56	4119	2.6	6.96	372	0
								8/25/2014	14:06:00	5.3	4117	2.6	6.98	372	0
								8/25/2014	14:07:00	5.28	4115	2.6	6.95	372	0
								8/25/2014	14:08:00	5.32	4123	2.6	6.96	372	0
								8/25/2014	14:09:00	5.42	4118	2.6	6.95	372	0
								8/25/2014	14:10:00	5.38	4117	2.6	6.95	372	0
								8/25/2014	14:11:00	5.53	4116	2.6	6.95	372	0
								8/25/2014	14:12:00	5.53	4112	2.6	6.95	372	0
								8/25/2014	14:13:00	5.45	4114	2.6	6.95	372	0
								8/25/2014	14:14:00	5.83	4122	2.6	6.94	372	0
								8/25/2014	14:15:00	5.86	4110	2.6	6.95	372	0
								8/25/2014	14:16:00	5.87	4105	2.6	6.91	372	0
								8/25/2014	14:17:00	5.35	4114	2.6	6.97	373	0
								8/25/2014	14:18:00	5.36	4099	2.6	6.95	373	0
								8/25/2014	14:19:00	5.41	4106	2.6	6.96	373	0
								8/25/2014	14:20:00	5.51	4106	2.6	6.95	373	0
								8/25/2014	14:21:00	5.73	4113	2.6	6.95	373	0

								8/25/2014	14:22:00	5.81	4108	2.6	6.96	373	0
								8/25/2014	14:23:00	5.58	4102	2.6	6.96	373	0
								8/25/2014	14:24:00	5.72	4110	2.6	6.95	373	0
								8/25/2014	14:25:00	5.6	4100	2.6	6.96	373	0
								8/25/2014	14:26:00	5.75	4100	2.6	6.95	373	0
								8/25/2014	14:27:00	5.71	4099	2.6	6.95	373	0
								8/25/2014	14:28:00	5.57	4097	2.6	6.95	373	0
								8/25/2014	14:29:00	5.65	4103	2.6	6.96	374	0
								8/25/2014	14:30:00	5.81	4091	2.6	6.96	374	0
								8/25/2014	14:31:00	5.79	4099	2.6	6.96	374	0
								8/25/2014	14:32:00	5.86	4101	2.6	6.95	374	0
								8/25/2014	14:33:00	5.75	4099	2.6	6.95	374	0
								8/25/2014	14:34:00	5.52	4098	2.6	6.95	374	0
								8/25/2014	14:35:00	5.39	4094	2.6	6.95	374	0
								8/25/2014	14:36:00	5.44	4104	2.6	6.96	374	0
								8/25/2014	14:37:00	5.48	4095	2.6	6.96	374	0
								8/25/2014	14:38:00	5.44	4095	2.6	6.96	374	0
								8/25/2014	14:39:00	5.32	4094	2.6	6.96	374	0
								8/25/2014	14:40:00	5.25	4097	2.6	7	374	0
								8/25/2014	14:41:00	5.44	4092	2.6	6.96	373	0
								8/25/2014	14:42:00	5.38	4096	2.6	6.96	373	0
								8/25/2014	14:43:00	5.39	4099	2.6	6.96	373	0
								8/25/2014	14:44:00	5.51	4094	2.6	6.96	373	0
								8/25/2014	14:45:00	5.55	4117	2.6	6.96	373	0
								8/25/2014	14:46:00	5.45	4096	2.6	6.96	374	0
								8/25/2014	14:47:00	5.4	4096	2.6	6.97	374	0
								8/25/2014	14:48:00	5.5	4097	2.6	6.95	374	0
								8/25/2014	14:49:00	5.53	4097	2.6	6.96	374	0
								8/25/2014	14:50:00	5.61	4090	2.6	6.96	374	0
								8/25/2014	14:51:00	5.31	4088	2.6	6.96	374	0

								8/25/2014	14:52:00	5.24	4095	2.6	6.96	374	0
								8/25/2014	14:53:00	5.15	4090	2.6	6.96	373	0
								8/25/2014	14:54:00	5.18	4089	2.6	6.96	373	0
								8/25/2014	14:55:00	5.15	4090	2.6	6.96	373	0
								8/25/2014	14:56:00	5.25	4096	2.6	6.96	373	0
								8/25/2014	14:57:00	5.2	4087	2.6	6.96	373	0
								8/25/2014	14:58:00	5.2	4088	2.6	6.96	373	0
								8/25/2014	14:59:00	5.23	4090	2.6	6.96	373	0
								8/25/2014	15:00:00	5.17	4088	2.6	6.96	373	0
								8/25/2014	15:01:00	5.2	4090	2.6	6.96	373	0
								8/25/2014	15:02:00	5.39	4084	2.6	7.16	373	0
								8/25/2014	15:03:00	5.28	4082	2.6	6.98	373	0
								8/25/2014	15:04:00	5.33	4078	2.6	7.02	373	0
								8/25/2014	15:05:00	5.13	4084	2.6	6.96	373	0
								8/25/2014	15:06:00	5.18	4084	2.6	6.96	373	0
								8/25/2014	15:07:00	5.18	4070	2.6	6.98	373	0
								8/25/2014	15:08:00	5.17	4075	2.6	6.97	373	0
								8/25/2014	15:09:00	5.24	4075	2.6	6.95	373	0
								8/25/2014	15:10:00	5.29	4075	2.6	6.96	373	0
								8/25/2014	15:11:00	5.15	4070	2.6	6.96	373	0
								8/25/2014	15:12:00	5.18	4071	2.6	6.96	373	0
								8/25/2014	15:13:00	5.17	4079	2.6	6.95	373	0
								8/25/2014	15:14:00	5.21	4073	2.6	6.96	373	0
								8/25/2014	15:15:00	5.31	4074	2.6	6.98	373	0
								8/25/2014	15:16:00	5.09	4075	2.6	6.98	373	0
								8/25/2014	15:17:00	5.1	4067	2.6	6.94	373	0
								8/25/2014	15:18:00	5.16	4069	2.6	6.95	373	0
								8/25/2014	15:19:00	5.15	4069	2.6	6.94	373	0
								8/25/2014	15:20:00	5.08	4068	2.6	6.96	373	0
								8/25/2014	15:21:00	5.12	4064	2.6	7	372	0

								8/25/2014	15:22:00	5.06	4065	2.6	6.96	372	0
								8/25/2014	15:23:00	5.15	4065	2.6	6.96	372	0
								8/25/2014	15:24:00	5.07	4070	2.6	6.96	373	0
								8/25/2014	15:25:00	5.1	4069	2.6	6.96	372	0
								8/25/2014	15:26:00	5.17	4062	2.6	6.96	372	0
								8/25/2014	15:27:00	5.17	4061	2.6	6.96	372	0
								8/25/2014	15:28:00	5.18	4064	2.6	6.96	373	0
								8/25/2014	15:29:00	5.16	4064	2.6	6.94	373	0
								8/25/2014	15:30:00	5.12	4066	2.6	6.95	373	0
								8/25/2014	15:31:00	5.15	4065	2.6	6.95	373	0
								8/25/2014	15:32:00	5.16	4058	2.6	6.96	373	0
								8/25/2014	15:33:00	5.19	4061	2.6	6.97	373	0
								8/25/2014	15:34:00	5.31	4065	2.6	6.96	373	0
								8/25/2014	15:35:00	5.3	4062	2.6	6.96	373	0
								8/25/2014	15:36:00	5.24	4056	2.6	6.92	373	0
								8/25/2014	15:37:00	5.16	4062	2.6	6.95	373	0
								8/25/2014	15:38:00	5.18	4058	2.6	6.95	373	0
								8/25/2014	15:39:00	5.22	4053	2.6	6.97	373	0
								8/25/2014	15:40:00	5.26	4054	2.6	6.97	373	0
								8/25/2014	15:41:00	5.22	4060	2.6	6.97	373	0
								8/25/2014	15:42:00	5.29	4061	2.6	6.97	373	0
								8/25/2014	15:43:00	5.29	4055	2.6	6.97	373	0
								8/25/2014	15:44:00	5.27	4050	2.6	6.95	373	0
								8/25/2014	15:45:00	5.24	4055	2.6	6.97	373	0
								8/25/2014	15:46:00	5.01	4052	2.6	6.98	373	0
								8/25/2014	15:47:00	5.11	4050	2.6	6.97	373	0
								8/25/2014	15:48:00	5.23	4055	2.6	6.98	373	0
								8/25/2014	15:49:00	5.16	4054	2.6	6.97	373	0
								8/25/2014	15:50:00	5.13	4051	2.6	6.95	374	0
								8/25/2014	15:51:00	5.1	4049	2.6	6.96	374	0

								8/25/2014	15:52:00	5.23	4054	2.6	6.96	374	0
								8/25/2014	15:53:00	5.22	4056	2.6	6.96	374	0
								8/25/2014	15:54:00	5.16	4048	2.6	6.96	374	0
								8/25/2014	15:55:00	5.09	4049	2.6	6.96	374	0
								8/25/2014	15:56:00	5.04	4046	2.6	6.96	374	0
								8/25/2014	15:57:00	5.15	4047	2.6	6.96	374	0
								8/25/2014	15:58:00	5.18	4045	2.6	6.96	374	0
								8/25/2014	15:59:00	5.19	4050	2.6	6.96	374	0
								8/25/2014	16:00:00	5.15	4042	2.6	6.96	374	0
								8/25/2014	16:01:00	5.09	4049	2.6	6.96	374	0
								8/25/2014	16:02:00	5.11	4043	2.6	6.93	374	0
								8/25/2014	16:03:00	5.1	4044	2.6	6.95	374	0
								8/25/2014	16:04:00	5.07	4045	2.6	6.96	374	0
								8/25/2014	16:05:00	5.15	4047	2.6	6.96	374	0
								8/25/2014	16:06:00	5.11	4044	2.6	6.96	374	0
								8/25/2014	16:07:00	5.09	4047	2.6	6.96	374	0
								8/25/2014	16:08:00	5.08	4043	2.6	6.98	374	0
								8/25/2014	16:09:00	5.18	4044	2.6	6.96	374	0
								8/25/2014	16:10:00	5.25	4039	2.6	6.96	374	0
								8/25/2014	16:11:00	5.11	4039	2.6	6.96	374	0
								8/25/2014	16:12:00	5.12	4042	2.6	6.96	374	0
								8/25/2014	16:13:00	5.11	4038	2.6	6.96	374	0
								8/25/2014	16:14:00	5.14	4041	2.6	6.97	374	0
								8/25/2014	16:15:00	5.23	4028	2.6	6.99	374	0
								8/25/2014	16:16:00	4.98	4037	2.6	6.94	374	0
								8/25/2014	16:17:00	8.39	10	0	7.28	373	5.65
								8/25/2014	16:18:00	7.98	0	0	7.52	371	10.25
								8/25/2014	16:19:00	8.31	0	0	7.65	370	10.44
								8/25/2014	16:20:00	8.81	0	0	7.73	371	10.45
								8/25/2014	16:21:00	9.32	0	0	7.77	370	10.35

								8/25/2014	16:22:00	9.85	0	0	7.77	370	10.3
								8/25/2014	16:23:00	10.35	0	0	7.76	369	10.18
								8/25/2014	16:24:00	10.84	0	0	7.72	367	10.05

APPENDIX D: Raw Data for Geochemical Sampling

Table D1. Geochemical Sampling from 2013.

Sample ID	Date	Time	Description	Well	pH	Temp (ºC)	Alkalinity (mg/L as CaCO3)	LDO (mg/L)	Cl (mg/L)	NO_3^- (mg/L as N)	SO_4^{2-} (mg/L)	Se (mg/L)	δD (‰)	δ18O (‰)	Comments
11000	15-Aug-13		Background	3	7.01	4.23	171	0	0.44	14.5	237	0.0734	-141	-18.77	Pre-Push-Pull Tests Samples
11001	15-Aug-13		Background	1S	5.33	4.27	354	0	1.42	113	1290	0.0130	-141.1	-18.81	
11002	16-Aug-13		Background	1D	6.82	3.7	343	0	2.12	129	1427	0.138			
11003	11-Sep-13		Background	3	7.10				0.45	13	237	0.0729			
11004	11-Sep-13		Background	1S	6.78		340		2.53	139	1338	0.0685			
11005	11-Sep-13		Background	1D	6.77		318		2.65	153	1447	0.184			
11006	24-Sep-13	9:23	Extraction Start	3	7.06	5.4	195	0							Aerated Water Spike 1
11007	24-Sep-13	10:38	Extraction 364L	3	7.06	5	196	0	0.81	17.05	276.76				
11008	24-Sep-13	11:37	Extraction End	3	7.08	5.8	191	0							
11009	24-Sep-13	12:42	Injection 100L	3	7.14	7.1	196	4.7							
11010	24-Sep-13		Injection 300L	3	7.18	7.3	189	7.2							
11011	24-Sep-13	13:48	Re-Extraction Start	3	7.22	8.1	195	6.8							
11012	24-Sep-13	14:41	Re-Extraction	3	7.14	7.1	202	3.7							
11013	25-Sep-13		Sample for Helium/Tritium Date Sample	3											Helium/Tritium Sample
11014	28-Sep-13	11:19	Extraction Start	3	6.99	4.8	207		1.11	16.53	277.9	0.0603	-140.4	-18.64	Aerated Water Spike 2
11015	28-Sep-13		DUP of 11014	3					1.15	16.46	277.95	0.0648	-140.6	-18.66	
11016	28-Sep-13	11:58	Extraction 273L	3	7.15	4.7	230								
11017	28-Sep-13	12:49	Extraction End (730L)	3	6.96	4.8	215								
11018	28-Sep-13	13:44	Injection 100L	3	7.21	4.6	236	3.73	1.11	16.5	276.97	0.0667	-140.6	-18.56	
11019	28-Sep-13	14:00	Injection 300L	3	7.13	4.6	202								
11020	28-Sep-13	14:26	Re-Extraction Start	3	7.25	4.8	218		1.18	16.42	277.46	0.0689	-140.8	-18.67	

11021	28-Sep-13	14:50	Re-Extraction 100L	3	7.21	4.8	207								
11022	28-Sep-13	15:20	Re-Extraction 200L	3	7.32	4.8	209								
11023	28-Sep-13	15:50	Re-Extraction 300L	3	7.18	4.8	223								
11024	28-Sep-13	16:20	Re-Extraction 400L	3	7.19	4.8	214								
11025	28-Sep-13	16:50	Re-Extraction 500L	3	7.15	4.8	239		1.16	16.69	276.1	0.0700	-140.8	-18.67	
11026	30-Sep-13	9:45	Start of Extraction	3	7.08	3.7	212								Push-Pull Test 1
11027	30-Sep-13	11:32	Extraction End	3	6.93	4.3	212		1.11	16.65	280.31	0.063738	-140.8	-18.59	
11028	30-Sep-13	11:32	DUP of 11027	3					1.16	16.69	279.88	0.065222	-140.9	-18.62	
11029	30-Sep-13	12:29	Injection Start	3	7.04	4.3	222	1.2	2069.88	17.02	270.68	0.064605	-18.8	-18.52	
11030	30-Sep-13		Blank	3					0.46	< 0.03	6.18	< 0.004	-141.1	-18.43	
11031	30-Sep-13	12:40	100L	3					617.35	16.1	263.74		-20.3	-18.54	
11032	30-Sep-13	12:58	300L	3				1.36	214.96	16.33	265.76		-40	-18.57	
11033	30-Sep-13	14:06	Injection End (500L)	3	7.00	4.4	211	1.58	119.35	16.25	277.03	0.065384	-58.7	-18.58	
11034	30-Sep-13	14:12	Clean Water Push	3	6.95	4.1	224								
11035	01-Oct-13	8:57	Re-extraction Start	3	6.34	3.7	187						-126.6	-18.5	
11036	01-Oct-13	10:30		3									-134.2	-18.61	
11037	01-Oct-13	11:30		3									-135.6	-18.53	
11038	01-Oct-13	11:30	DUP of 11037	3											
11039	01-Oct-13	12:30		3									-136.4	-18.54	
11040	01-Oct-13	13:30		3									-136.9	-18.45	
11041	01-Oct-13	14:30		3									-137.5	-18.52	
11042	01-Oct-13	15:30		3									-137.8	-18.58	
11043	02-Oct-13	9:00		3									-138.5	-18.51	
11044	02-Oct-13	11:00		3									-139	-18.52	
11045	02-Oct-13	13:00		3									-138.8	-18.64	

11046	02-Oct-13	15:00		3									-140	-18.87	
11047	03-Oct-13	8:45		3	6.99	3.8	212						-138.6	-18.85	
11048	03-Oct-13	8:45	DUP of 11047	3									-140.3	-18.98	
11049	03-Oct-13	11:30		3	7.30	5.6	215						-141.1	-18.93	
11050	03-Oct-13	12:30		3	7.27	5.3	217						-141	-18.88	
11051	03-Oct-13	15:20		3	7.16	5.7	214						-141	-18.89	
11052	03-Oct-13	17:15		3	6.97	5	224		4.51	17.87	281.98	0.0697	-140.9	-18.81	
11053	01-Oct-13	8:57	Begin Extraction	3	6.34	3.7	187		34.21	16.41	276.09	0.0673	-127.50	-18.33	
11054	01-Oct-13	9:09		3											
11055	01-Oct-13	9:14		3											
11056	01-Oct-13	9:20		3	7.03	4.6									
11057	01-Oct-13	9:20	DUP of 11056	3											
11058	01-Oct-13	9:30		3											
11059	01-Oct-13	9:40		3	7.26	4.7			33.46	17.18	275.52	0.0719	-131.80	-18.79	
11060	01-Oct-13		Blank	3											
11061	01-Oct-13	9:49		3											
11062	01-Oct-13	9:54		3											
11063	01-Oct-13	10:00		3											
11064	01-Oct-13	10:09		3											
11065	01-Oct-13	10:14		3											
11066	01-Oct-13	10:20		3	6.50	4.5			25.77	17.08	276.26	0.0690	-133.00	-18.58	
11067	01-Oct-13	10:20	DUP of 11066	3											
11068	01-Oct-13	10:28		3											
11069	01-Oct-13	10:40		3	6.17	4.8									
11070	01-Oct-13	10:49		3											
11071	01-Oct-13	10:55		3											
11072	01-Oct-13	11:00		3	6.48	4.6			21.66	17.01	277.11	0.0664	-134.50	-18.59	

11073	01-Oct-13	11:09		3											
11074	01-Oct-13	11:14		3											
11075	01-Oct-13	11:20		3	6.59	4.7									
11076	01-Oct-13	11:29		3											
11077	01-Oct-13	11:40		3	7.87	4.5			19.18	17.07	277.64	0.0690	-135.50	-18.68	
11078	01-Oct-13	11:40	DUP of 11077	3					19.14	17.03	277.77	0.0665	-135.10	-18.45	
11079	01-Oct-13	11:49		3											
11080	01-Oct-13	12:00		3	6.74	4.8									
11081	01-Oct-13	12:04		3											
11082	01-Oct-13	12:09		3											
11083	01-Oct-13	12:20		3	6.54	4.8			17.43	17.09	278.93	0.0673	-136.40	-18.57	
11084	01-Oct-13	12:29		3											
11085	01-Oct-13	12:40		3	6.46	4.6									
11086	01-Oct-13	12:49		3											
11087	01-Oct-13	12:54		3											
11088	01-Oct-13	13:00		3	6.28	4.6			15.84	17.23	279.24	0.0658	-137.30	-18.63	
11089	01-Oct-13	13:00	DUP of 11088	3											
11090	01-Oct-13		Blank	3											
11091	01-Oct-13	13:14		3											
11092	01-Oct-13	13:20		3	6.09	4.8									
11093	01-Oct-13	13:40		3	7.76	4.5									
11094	01-Oct-13	13:49		3											
11095	01-Oct-13	14:00		3	5.42	4.3			14.56	17.32	280.05	0.0661	-136.60	-18.06	
11096	01-Oct-13	14:09		3											
11097	01-Oct-13	14:14		3											
11098	01-Oct-13	14:20		3	6.48	4.7									
11099	01-Oct-13	14:20	DUP of 11098	3											
11100	01-Oct-13	14:34		3											
11101	01-Oct-13	14:40		3	6.42	4.5									

11102	01-Oct-13	14:49		3											
11103	01-Oct-13	15:00		3					13.5	17.38	280.73	0.0676	-136	-18.04	
11104	01-Oct-13	15:21		3											
11105	01-Oct-13	15:30		3	6.39	5.3									
11106	01-Oct-13	15:45		3											
11107	01-Oct-13	16:00		3					12.91	17.48	282.07	0.0653	-136.6	-18.12	
11108	01-Oct-13	16:00	DUP of 11107	3											
11109	01-Oct-13	16:15		3											
11110	01-Oct-13	16:30		3											
11111	01-Oct-13	16:45		3											
11112	01-Oct-13	16:55		3					11.75	17.43	281.99	0.0657	-137.1	-18.12	
11113	02-Oct-13	8:43		3	7.15	4.3									
11114	02-Oct-13	9:07		3											
11115	02-Oct-13	9:12		3	7.71	3.6	211		10.38	16.51	275.85	0.0663	-138.2	-18.43	
11116	02-Oct-13	9:27		3											
11117	02-Oct-13	9:42		3	7.92	3.6	219								
11118	02-Oct-13	9:42	DUP of 1117	3											
11119	02-Oct-13	9:57		3											
11120	02-Oct-13		Blank	3											
11121	02-Oct-13	10:12		3	8.35	4.4	220								
11122	02-Oct-13	10:27		3											
11123	02-Oct-13	10:42		3	8.28	4.7									
11124	02-Oct-13	11:12		3	8.18	5.8	213								
11125	02-Oct-13	11:30		3											
11126	02-Oct-13	11:42		3	8.07	9.8	218		9.53	17.48	282.13	0.0672	-138.2	-18.31	
11127	02-Oct-13	11:42	DUP of 11126	3											
11128	02-Oct-13	12:15		3											
11129	02-Oct-13	12:42		3											
11130	02-Oct-13	13:15		3					0.5	0.04	0.39				

11131	02-Oct-13			3	7.90	7.9	211		9.31	17.81	283.84	0.0668	-138.3	-18.2	
11132	02-Oct-13	14:15		3											
11133	02-Oct-13	15:17		3	8.35	6.7	223					0.0652	-138.4	-18.37	
11134	03-Oct-13	9:30		3	7.22	4.2									
11135	03-Oct-13	10:30		3	7.21	5	228								
11136	03-Oct-13	14:20		3	7.27	5.1	231								
11137	03-Oct-13	16:20		3	7.32	5.3	227								

Table D2. Geochemical Sampling from 2014.

Sample ID	**Date**	**Time**	**Description**	**Well**	**pH**	**Temp** (ºC)	**Alkalinity** (mg/L as CaCO3)	**Cl** $^-$ (mg/L)	**NO** $_3^-$ (mg/L as N)	**SO** $_4^{2-}$ (mg/L)	**Se** (mg/L)	**δD** (‰)	**δ18O** (‰)
11200	22-May-14	12:27	Background	1S	7.3		95	4.16	197.02	1493.82	0.105785	-143.797	-18.0225
11201	22-May-14	13:13	Background	1D	7.3		170	3.92	172.82	1577.41	0.011779	-144.18	-18.4536
11202	22-May-14	14:55	Background	3	7.3		156	1.72	26.3	449.81	0.050387	-145.162	-18.8899
11203	22-May-14		Re-run 11200	1S							0.116209		
11204	22-May-14		Re-run 11201	1D							0.014338		
11205	06-Jun-14		Aborted P-P test	3	7.3		181	1.27	16.12	249.24	0.057413	-145.471	-19.3231
11206	06-Jun-14		Aborted P-P test	3	7.4		188	1.25	16.31	247.41	0.053932	-150.082	-19.1172
11303	13-Jun-14		Spring near well 3					0.8617	1.8673	121.5857	0.028963	-145.569	-19.3285
11304	13-Jun-14		Spring near well 1					4.0244	<0.05	1376.09	0.267325	-147.283	-18.8741
11353	14-Jul-14	9:15	After Purge	3	7.44	9.9	159	3.30342	13.01856412	211.378566	0.062693	-145.287	-19.6497
11354	14-Jul-14	9:15	After Purge	3	7.4	11.1	160	2.996041	13.05392251	211.366993	0.063343	-146.822	-19.7651
11355	14-Jul-14	11:17	After Purge	4	7.33	11.4	231	2.236844	40.90259675	940.303812	0.131822	-144.482	-18.9234
11356	14-Jul-14	12:28	After Purge	1S	7	12.4	353	1.328862	59.86402153	734.843857	0.267595	-147.693	-18.7933
11357	14-Jul-14	12:28	After Purge	1S	6.88	13.4	349	1.199732	79.75997248	1080.72336	0.276126	-145.46	-18.6607
11358	14-Jul-14	13:35	After Purge	1D	7.13	11.3	379	1.652635	71.84696295	1322.82657	0.042695	-143.988	-18.3495

11359	14-Jul-14	13:35	After Purge	1D	7.17	13	391	0.252774	14.94640816	954.481164	0.041491	-146.009	-18.8942
11360	16-Jul-14	8:17	After Purge	2	6.72	6.8	371	11.9236	175.3554	1450.102	0.285796	-146.004	-18.2799
11457	13-Aug-14	12:44	Final Pump Out	3	7.2	11.7	178	2.45153	11.83887144	207.830762	0.071213	-145.101	-19.3176
11458	13-Aug-14	12:44	Final Pump Out	3				3.013898	11.77664375	207.284623	0.070437	-146.149	-19.9261
11547	01-Oct-14	14:25	During pump out	1D				6.5842	138.6075	1616.87	0.170729		
11548	01-Oct-14		During pump out	1D				7.2248	138.5419	1609.62	0.172202		
11549	01-Oct-14		During pump out	1D				7.1845	139.5584	1626.73	0.181811		
11550	06-Oct-14	17:23	Final Pump Out	1D				7.815211	145.9551	1659.4528	0.142949	-143.064	-17.9445
11551	06-Oct-14	17:23	Final Pump Out	1D				3.467443	146.0646	1610.693	0.153213	-148.155	-17.9485

Table D3. Geochemical data for the wells at Henretta from FRO Staff sampling.

Well	Date	Se (mg/L)	SO4 (mg/L)	NO3 (mg/L as N)
1D	November 9, 2012	0.0091	1410	129
1D	March 28, 2013	0.00446	1500	154
1D	May 28, 2013	0.0146	1460	149
1D	September 25, 2013	0.168	1550	176
1D	September 25, 2013	0.167	1560	177
1D	December 9, 2013	0.184	1660	203
1D	March 12, 2014	0.125	1640	197
1D	May 13, 2014	0.0238	1620	181
1D	September 30, 2014	0.11	1710	161
1D	October 22, 2014	0.0665	1760	170
1D	January 19, 2015	0.103	1780	175
1D	April 14, 2015	0.0205	1650	169
1S	November 9, 2012	0.00951	1230	122
1S	March 28, 2013	0.006	1330	160
1S	May 29, 2013	0.00907	1320	147
1S	September 11, 2013	0.068515	1337.9	139
1S	September 29, 2013	0.0519	1400	159
1S	December 9, 2013	0.16	1520	212
1S	March 12, 2014	0.158	1490	227
1S	May 13, 2014	0.1485	1545	209
1S	May 22, 2014	0.011779	1493.82187	197
1S	September 30, 2014	0.236	1640	184
1S	October 22, 2014	0.215	1640	188
1S	January 19, 2015	0.202	1580	199
2	April 14, 2015	0.197	1570	197
2	November 9, 2012	0.184	1100	236
2	March 28, 2013	0.224	1250	255
2	May 29, 2013	0.224	1220	221
2	September 30, 2013	0.516	1250	257
2	March 12, 2014	0.267	1450	216
2	August 25, 2014	0.329	1560	224
2	October 23, 2014	0.385	1610	210
2	April 14, 2015	0.461	1600	179
3	November 8, 2012	0.00124	259	1.8
3	March 27, 2013	0.00097	452	28.2
3	May 28, 2013	0.0334	404	28.4
3	August 29, 2013	0.0595	291	18.9

3	September 11, 2013	0.072884	236.52278	13.0
3	September 27, 2013	0.0562	286	18.6
3	December 9, 2013	0.0497	270	15.1
3	March 12, 2014	0.0457	255	11.2
3	May 13, 2014	0.0578	368	23.1
3	May 22, 2014	0.050387	449.814	26.3
3	August 25, 2014	0.0512	226	12.6
3	October 22, 2014	0.0385	220	9.98
3	January 21, 2015	0.0544	243	15.1
3	April 14, 2015	0.0483	304	15.6
4	November 8, 2012	0.026	813	25.6
4	March 27, 2013	0.0567	600	28.7
4	May 28, 2013	0.134	495	51.8
4	September 25, 2013	0.0514	1010	36.6
4	December 9, 2013	0.0223	1030	27.1
4	March 12, 2014	0.01155	1001.5	14.2
4	May 13, 2014	0.266	950	75.5
4	August 25, 2014	0.0737	1040	38.6
4	October 22, 2014	0.0435	1070	34.4
4	January 19, 2015	0.025	1110	26.0
4	April 14, 2015	0.0734	1010	26.5
5	November 8, 2012	<0.00010	18.8	<0.0050
5	March 27, 2013	<0.00010	16.7	<0.0050
5	May 28, 2013	<0.00010	15.2	<0.0050
5	May 14, 2014	na	24	na
5	October 23, 2014	na	22.9	na

Table D4. Geochemical data for the Henretta Creek from FRO Staff sampling.

Location	**Date**	**Se (mg/L)**	**SO4 (mg/L)**	**NO3 (mg/L as N)**
HC1	January 7, 2014	0.0393	195	9.37
HC1	February 4, 2014	0.0404	195	9.23
HC1	March 4, 2014	0.0399	206	9.54
HC1	April 7, 2014	0.0441	221	10.2
HC1	May 5, 2014	0.0362	171	8.33
HC1	June 2, 2014	0.00598	36.4	1.53
HC1	July 8, 2014	0.00688	41	1.66
HC1	August 5, 2014	0.0169	88.7	3.8
HC1	September 8, 2014	0.00878	64.6	2.38
HC1	October 6, 2014	0.0173	105	4.16
HC1	November 3, 2014	0.0201	121	5

HC1	December 2, 2014	0.0337	144	6.81
HC1	January 5, 2015	0.0291	167	7.62
HC1	February 2, 2015	0.0321	187	8.1
HC1	March 2, 2015	0.0333	197	8.64
HC1	March 16, 2015	0.0335	196	8.78
HC1	March 23, 2015	0.0381	208	9.76
HC1	March 30, 2015	0.034	196	9.3
HC1	April 7, 2015	0.0369	186	8.93
HC1	April 13, 2015	0.038	182	8.72
HC1	April 20, 2015	0.025	155	6.72
HC1	April 27, 2015	0.0182	109	4.89
HC1	May 4, 2015	0.0115	74.6	3.05
HC1	May 11, 2015	0.00932	61.6	2.37
HC1	May 19, 2015	0.00641	51.1	1.73
HC2	February 7, 2011	0.0179	na	5.41
HC2	April 5, 2011	0.0273	161	7.04
HC2	April 11, 2011	0.031	172	7.6
HC2	April 18, 2011	0.0312	177	7.78
HC2	April 26, 2011	0.0266	156	6.61
HC2	May 2, 2011	0.0337	174	7.62
HC2	May 9, 2011	0.0237	133	5.44
HC2	May 16, 2011	0.0145	53.2	2.37
HC2	May 24, 2011	0.00424	26.4	1.17
HC2	May 30, 2011	0.00892	51.9	1.97
HC2	June 6, 2011	0.00288	17.2	0.786
HC2	June 13, 2011	0.00371	21.7	0.962
HC2	June 20, 2011	0.00396	22.7	1.01
HC2	June 27, 2011	0.00882	35.7	1.17
HC2	July 5, 2011	0.00745	43.2	0.767
HC2	July 11, 2011	0.00574	33.4	1.27
HC2	July 18, 2011	0.0053	31.3	1.43
HC2	August 2, 2011	0.00833	44.6	2.33
HC2	August 9, 2011	0.0103	56.9	3.14
HC2	September 6, 2011	0.016	82.9	4.08
HC2	October 3, 2011	0.0215	110	5.43
HC2	November 7, 2011	0.0358	146	8.56
HC2	December 5, 2011	0.0317	140	8.54
HC2	January 11, 2012	0.0289	159	7.95
HC2	February 6, 2012	0.0327	160	8.17
HC2	March 6, 2012	0.0367	172	8.72
HC2	March 20, 2012	0.0357	170	8.16

HC2	March 27, 2012	0.0376	178	8.99
HC2	April 3, 2012	0.0373	184	9.52
HC2	April 10, 2012	0.0422	194	10.1
HC2	April 16, 2012	0.0415	188	8.92
HC2	April 23, 2012	0.026	124	5.16
HC2	May 1, 2012	0.0247	99.8	5.49
HC2	May 7, 2012	0.0303	121	6.6
HC2	May 14, 2012	0.00787	38.3	1.89
HC2	May 22, 2012	0.00775	37.2	1.74
HC2	May 28, 2012	0.0119	55.6	2.66
HC2	June 4, 2012	0.00443	24.4	1.12
HC2	June 11, 2012	0.00617	28.8	1.5
HC2	June 18, 2012	0.0035	18.5	0.931
HC2	June 25, 2012	0.0026	14.1	0.715
HC2	July 3, 2012	0.00485	22.5	1.22
HC2	July 7, 2012	0.005	23.9	1.31
HC2	August 8, 2012	0.012	55.4	2.79
HC2	September 4, 2012	0.0226	98.1	5.16
HC2	October 1, 2012	0.0277	123	6.2
HC2	November 5, 2012	0.0294	131	6.32
HC2	December 4, 2012	0.0336	149	8.35
HC2	January 7, 2013	0.0382	164	8.62
HC2	February 4, 2013	0.0406	175	9.37
HC2	March 4, 2013	0.0425	181	9.65
HC2	April 1, 2013	0.041	183	9.89
HC2	May 7, 2013	0.0106	59.1	2.35
HC2	June 3, 2013	0.00619	32.5	1.43
HC2	June 24, 2013	0.0134	49.6	3.36
HC2	July 3, 2013	0.0117	49.6	2.44
HC2	July 8, 2013	0.0159	42	3.28
HC2	August 6, 2013	0.018	59.7	3.55
HC2	September 4, 2013	0.0376	74.7	7.25
HC2	October 7, 2013	0.0298	137	5.85
HC2	November 4, 2013	0.0336	120	6.66
HC2	December 3, 2013	0.0452	134	10.1
HC2	January 7, 2014	0.0413	159	7.95
HC2	February 4, 2014	0.0434	170	8.07
HC2	March 4, 2014	0.0431	173	8.42
HC2	April 7, 2014	0.0509	182	8.98
HC2	May 5, 2014	0.0385	203	7.3
HC2	June 2, 2014	0.00533	155	1.09

HC2	July 7, 2014	0.00708	27.9	1.39
HC2	August 5, 2014	0.0171	37.8	3.25
HC2	September 8, 2014	0.008	81.7	1.75
HC2	October 6, 2014	0.0169	55.4	3.24
HC2	November 3, 2014	0.0205	94.6	4.21
HC2	December 2, 2014	0.0362	111	5.7
HC2	January 5, 2015	0.0284	131	5.44
HC2	February 2, 2015	0.0322	143	6.23
HC2	March 2, 2015	0.0332	163	6.37
HC2	April 7, 2015	0.0387	168	7.75
HC2	May 4, 2015	0.0103	168	2.26
HC2	June 1, 2015	0.00381	62.5	0.779
HC2	July 6, 2015	0.0104	25.8	2.07
HC2	August 11, 2015	0.0181	59.8	3.44
HC2	September 9, 2015	0.0153	92.8	3.19
HC2	October 6, 2015	0.0134	93	2.85
HC2	November 4, 2015	0.0204	91.1	4.06
HC2	December 9, 2015	0.0329	116	7.65
HC2	January 4, 2016	0.0262	141	5.17
HC2	January 4, 2016	0.0267	150	5.16
HC2	January 4, 2016	na	150	na